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MUNICIPAL HOUSECLEANING

WILLIAM PARR CAPES
AND
JEANNE D. CARPENTER

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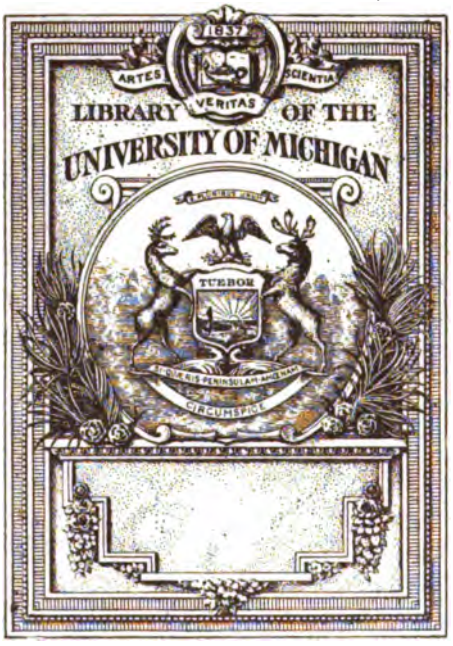
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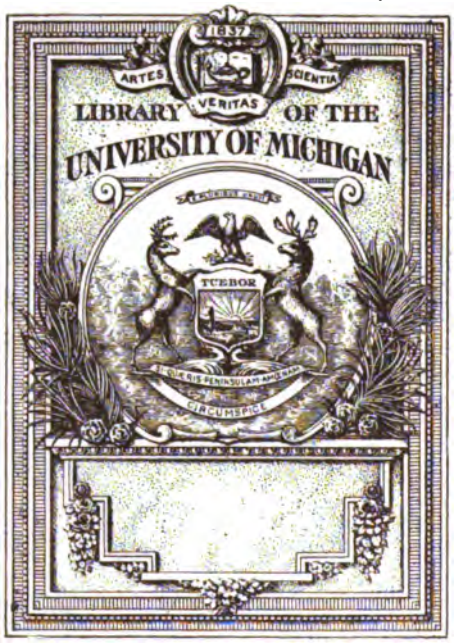
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MUNICIPAL HOUSECLEANING

THE METHODS AND EXPERIENCES OF AMERICAN CITIES IN COLLECTING AND DISPOSING OF THEIR MUNICIPAL WASTES—ASHES, RUBBISH, GARBAGE, MANURE, SEWAGE, AND STREET REFUSE

BY

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PRESIDENT OF NEW YORK STATE CONFERENCE OF MAYORS AND
OTHER CITY OFFICIALS

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DEDICATED

TO THE

HONORABLE CHARLES C. DURYEE, M.D.

WHO, AS THE FOUNDER AND FIRST PRESIDENT OF THE NEW YORK STATE CONFERENCE OF MAYORS AND OTHER CITY OFFICIALS, WHICH DEVELOPED THAT UNIQUE INSTITUTION, THE STATE BUREAU OF MUNICIPAL INFORMATION, RENDERED A SERVICE OF INESTIMABLE VALUE TO THE CITIES OF THE EMPIRE STATE AND BLAZED A TRAIL FOR BETTER COORDINATION OF MUNICIPAL UNDERTAKINGS, AND MORE EFFECTIVE COOPERATION AMONG AMERICAN CITIES.

326645

PREFACE

In a home free from nuisances which offend the esthetic tastes, and either directly or indirectly cause disease, more contentment and thrift will be found than in the one permeated with odors and befouled with dirt and domestic wastes.

So it is with a city, the great home, workshop, and playground of its people. Keeping it clean, therefore, is one of the most important duties of its officials. None other is more conducive to health, happiness and comfort, the three great objects for which every community through organized effort is striving.

And there is no group of municipal problems which demands and is now commanding, more scientific thought and more intelligent business management than the collection and disposal of a city's wastes. With every nation applying the last ounce of economy and with the increase of population and its consequent congestion, these problems grow in importance and complexity. Higher living standards, a better understanding of the causes of disease, and a keener appreciation of preventive work have forced municipalities to frown upon primitive methods involving individual effort, especially where congestion exists. As a substitute therefore, more effective means have been and are being adopted to eliminate by community activity, the nuisances caused by ashes, rubbish, garbage and dirty streets. We are also appreciating the need for more efficient management than is now prevalent and for the development of revenue-producing by-products.

An official or layman interested in the solution of these six important municipal housecleaning problems will find

in this book information which we believe will answer all his questions. Our judgment has been influenced entirely by the hundreds of questions which have come to the State Bureau of Municipal Information from city officials in their effort either to establish efficient systems or to reorganize existing ones.

City officials, federal, state and municipal reports, engineering, medical and other publications, as well as the proceedings of various municipal, civic and scientific organizations have contributed their quota to this work.

THE AUTHORS.

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INTRODUCTION

NEVER in the history of our country has the work of the public official demanded so much of him as now. The expansion and increasing complexity of municipal activities, the desire of women for more knowledge about their new responsibilities, the need for better living conditions brought about by greater congestion, the necessity for conserving every ounce of man and woman power, the demand for greater efficiency and rock-bottom economy in every line—all these conditions are making themselves felt with the public official.

The time when public office was held by the grace of God and the majority of votes has become almost a thing of the past. The official's worth now is not measured by his good-fellowship and vote-getting capacity, but rather by his ability to produce results—not at the polls on Election Day, but in the City Hall every day.

Because municipal government is closer to the people and affects them in more ways than the government of any other political subdivision, and also because our citizens are now taking a keener interest than ever before in community work, it is to-day almost useless for a public official to attempt to escape responsibility or to excuse his shortcomings. He must be efficient and constantly apply his efficiency.

I believe that most of our urban citizens appreciate the importance of keeping our cities clean and healthful by the proper removal and disposal of the mass of wastes that accumulates daily. I know that every public official appreciates the need for this service, and most of them by bitter experiences realize the complexity of these problems.

To equip himself to do his difficult duty as he should, the

public official must be able to acquaint himself thoroughly with the best methods, experiences and opinions of others. "Municipal Housecleaning" goes into all of the matters pertaining to the collection, care and removal of municipal wastes. It should be of the greatest value in assisting public officials—mayors, engineers, sanitarians and members of health, street cleaning, public works and sewer departments —to select the systems best adapted to local conditions and to operate them efficiently. We officials in New York State have found this information to be of inestimable value in solving our problems.

But no municipal effort can succeed without the co-operation of the citizen. He can help most by informing himself on these problems so that he can intelligently participate in the cooperative community effort to keep clean, and if need be, to offer constructive criticism. If the citizen —and particularly the woman, for it is her intelligent co-operation that will make for more effective service—will read this book, it will be easier for us to obtain in America what the authors have so aptly referred to as "better places in which to live, work and play."

CORNELIUS F. BURNS,
President New York State Conference
of Mayors and other City Officials.

STREET CLEANING

STREET CLEANING

SYSTEMS AND APPARATUS USED IN AMERICAN CITIES—METHODS OF REDUCING LITTER—COST DATA.

In establishing or rearranging its street cleaning system, every city must consider the problem from three angles: (1) Cheapest method of cleaning pavement; (2) Method of reducing litter; (3) Paving policy with a view to saving cost of cleaning.

The proper solution of each one of these problems will materially reduce the cost.

In outlining a program for a street cleaning department the following elements must be known and carefully considered:

(1) Kind of and state of repair of pavement.
(2) Traffic to which they are subjected.
(3) Facilities for disposing of street sweepings.
(4) Climatic peculiarities.
(5) Degree of cleanliness it is desired or expected to maintain.
(6) Miscellaneous local circumstances.

Mr. S. Whinery, Consulting Engineer, says that in most cities the data afforded by local past experience and results, furnish the best basis for future projects and programs. Unfortunately few cities have records of these. The head of the department usually relies upon his own memory or that of his predecessor. While the methods followed and results obtained in other cities may and should be studied, it must be borne in mind that it is not safe to base conclusions upon such data without a full knowledge and careful

consideration of all facts and conditions affecting them. This is particularly true of reported cost data, for in addition to differing physical conditions, it is unfortunately true that the present methods of accounting in many street cleaning departments make it next to impossible to ascertain the actual or relative unit cost of the various details of the work, and intelligently to compare results in one city with those in another. The experience of the New York State Bureau of Municipal Information in seeking data from the fifty largest American and all New York State cities provides ample proof of this condition. Fifty were able to give some data, but of these only a few had any accurate and detailed cost statistics.

The relative amount of dirt from the different sources of dust depends on the character of construction and condition of street surface, amount and character of traffic, character of neighborhood and people in the neighborhood, and street railway tracks.

Street dirt is divided into two general classes: (a) Natural, and therefore unavoidable, and (b) that due to carelessness and therefore avoidable. In the first class are dust from the air, and dirt coming from the wear of pavements, vehicles, tires and horses' shoes; excrement of animals, dirt and sand which work up through the joints of pavements, laid on earth or sand foundations and having sand or gravel joints; dirt brought in from adjacent unpaved or macadam streets, and leaves from shade trees. In the second class are soot, refuse swept from sidewalks, thrown from buildings and discarded by pedestrians, dirt dropped from overloaded vehicles and débris from construction operations.

The real duty of the street cleaning department is the removal of the first class, but in doing so it is compelled also to sweep up and cart away the material in the second class. In order to reduce its operations as much as possible, it must, therefore, in cooperation with the police and health authorities do everything it can to prevent the accumula-

tion of the avoidable material by enforcing ordinances and through the cooperation of the public in general.

Contract vs. Municipal Cleaning

It is generally agreed that street cleaning by municipal employees is more satisfactory and economical than by contract. Even the officials of those few cities which still have the contract system favor municipal operation. Philadelphia is the only one of the twenty-five largest cities in the country which does the work by contract. The chief of the highway department has recommended a change, giving the following reasons: "Street cleaning work involves so much detail for which there are no definite units to specify and bid for, and it is of such a character that the overhead charges for proper inspection are so disproportionate to the cost of the work, that unquestionably it would be much more effectively and economically carried on directly by the municipal forces instead of by contract."

Washington's experience is illuminating. Notwithstanding changes in method as work progressed and considerable expense attached to the purchase of new equipment the street cleaning department was able to show at the end of the year under the municipal system that the average costs were less than contract prices. At the end of the second year for the expenditure of the same amount of money over 25 per cent. more work was accomplished than during the last year of the contract system and the general opinion was that the streets were in better condition than they had ever been before.

Method of Reducing Litter

Street cleaning departments of many progressive cities within the last few years have given particular attention to the preventive side of street cleaning work, *i. e.*, reducing the amount of avoidable dirt on street pavements. Various

methods have been adopted to secure results. Local civic pride and the cooperation of the public have been stimulated by means of educational campaigns. One result has been the more general use of waste paper and refuse street cans. Cleveland tried to organize volunteer corps among the school children to use their influence against the useless littering of streets. Departments have also established a closer relationship with the health and police authorities for the enforcement of street cleaning regulations, such as those prohibiting the sweeping of litter from stores and houses onto paved streets. The success of preventive work depends upon the amount of cooperation the street cleaners can get from these sources.

In Chicago an analysis was made of the character and percentage of waste thrown about by pedestrians in the streets and by business houses in densely populated sections of the city. It was found that a great portion of the street dirt collected by street cleaners consisted of waste paper and other light litter. The Chicago Civil Service Commission in a special report says: "It would appear that with the cooperation of merchants a considerable portion of such litter could be kept off the streets and if street cleaners would patrol the street for loose paper and deposit the same in the street dirt boxes provided at different points along such streets, a great portion of the cleaning work would be saved and the streets would generally appear cleaner. The litter of streets in tenement and manufacturing districts is a matter which can be greatly minimized by proper distribution of work and cooperation of the street cleaning forces and residents. The quantity of street dirt collected from the pavements in market places illustrates an instance where pavements become unavoidably littered."

Gustave H. Hanna, when head of the Cleveland Street Cleaning Department, expressed the belief that nothing encourages carefulness on the part of the public so much as efficient and careful cleaning. He argued that a man does

not hesitate to throw paper or rubbish into a foul street, but thinks twice if the street is clean. If there is a waste box at hand with a printed suggestion on the outside, Mr. Hanna thinks he is apt to use the box.

The greatest source of expense comes from those who use the street as a place of business, such as resorts of professional hucksters. Mr. Hanna and others think it would be a small return for the permission of doing business in these streets to require the hucksters to keep the surroundings clean at their own expense under pain of arrest or forfeiture of privilege.

In an effort to get the cooperation of the general public, Philadelphia placed waste paper receptacles in prominent locations throughout the city, such as two in every block in the principal business sections, in front of school houses and entrances to business, elevated and subway stations, etc. Circulars were sent to each householder throughout the city containing information and instruction as to improving conditions by using uniform and suitable receptacles.

Bulletins and letters of information were distributed among business and civic associations. The officials learned that one of the most effective methods in reaching the householder is through the women's organizations. A woman inspector was appointed to keep in touch with the activities of the women's clubs and to secure their cooperation. This inspector during the year gave over two hundred lectures to various organizations and enlisted the cooperation of householders, women and children in connection with preventive street cleaning measures. To the housekeeper it was shown how vital is her part in an efficient collection of all waste. Children were impressed with their duties as citizens, and to them was given an opportunity to demonstrate their knowledge in the home, school and on the street. As a reward of such activity 5,000 buttons were distributed in six months. Twenty thousand folders for

children and adults relating to the care of streets and the collection of waste were also put into circulation.

Former Street Cleaning Commissioner William H. Edwards, of New York, says that four kinds of cooperation are needed by street cleaning departments:

(1) "Cooperation with the force by showing a human interest in the work of the men. This can be done by establishing a pension fund so that when a man has served faithfully for twenty years and has reached the age of 60 or has become incapacitated after he has served ten years, or is injured in the performance of his duty at any time after service has begun so that he is disabled for future service, he can be retired on half pay. This instills in men a keen desire to do better work and permits the Commissioner to retire men who are no longer able to do good work. The danger of street sweepers in busy streets is apparent to any one. More than 2,500 accidents resulting in death or personal injury or damage to property occurred in one year in connection with the New York City Department's activities. The percentage of killed in the street cleaning force was considerably higher than that in the police force.

(2) "Cooperation of women in the communities in New York. The Women's Municipal League and other bodies have cooperated with the department. Every year they offer a medal to the sweeper, driver or foreman who does the best all around work.

(3) "Cooperation with citizens. Carelessness up to the present time has added to the work and expense and has been an obstacle to real cleanliness. It must be remembered that before the sweeper can begin that part of the work which is beyond prevention, he must remove the litter carelessly thrown on the street.

(4) "The formation of ordinances for the prevention of this carelessness. If the department has the effective cooperation of the police department and of the magistrates, in the enforcement of the ordinances, then and only

then can this particular condition be reduced to a practical minimum. In an attempt to enforce ordinances forbidding the throwing of litter in the streets, New York City in 1915 caused the arrest of 5,400 persons for violating ordinances relating to street conditions of the scattering of refuse. In addition to these arrests in the last three months of the year more than 18,000 formal written warnings were issued for the violation of ordinances."

Street Cleaning Factors and Standards

The conditions and factors controlling the amount and frequency of cleaning of any pavement, are as follows:

1. Density of horse drawn vehicles and other traffic.
2. Width of street.
3. Character of district and population.
4. Location of streets.
5. Proximity of streets and alleys.
6. Location of public buildings, parks, etc.
7. Kinds and condition of pavement.

A study made by the Chicago Civil Service Commission definitely established that the density of horse traffic, which is the total number of horses passing through a given street divided by the width of the street, is the principal factor which determines the number and frequency of cleanings one street should be given.

The Commission has also learned that there are at least thirty-eight distinct movements which a street cleaner makes in street cleaning work. Of these some have been found to be unproductive, resulting in loss of time and energy and less effective street cleaning. The most important of these, according to the Commission's report, are as follows: Observation of time wheeling push carts into alleys or other dumping places, disclosing that practically one-fifth of time was consumed in this activity. The study disclosed that some sweepers are more efficient than others,

due to the stroke of the broom which they make. The practise of hitting a broom on the pavement is not necessary on dry pavements and very seldom on wet pavements. Effective and practical street cleaning can be obtained by bringing the brush down forcibly at the beginning of each stroke, thus reducing the work at least 15 per cent. The time schedules disclosed that time lost by street cleaners in dodging horses and automobiles where traffic is dense is unappreciable and does not exceed 8 per cent. of the total time in the business district and not more than 2 per cent. of the total time in the outlying district. It is occasioned more through congestion of traffic than through density of traffic. In cleaning light traffic asphalt pavements it was disclosed that after the one morning thorough cleaning three-fourths of the area to be covered during the remainder of the day does not require thorough cleaning. The Commission believes that scoops equipped with rollers would be well adapted for use on light traffic pavements, and with them one man could patrol a much larger pavement area and still keep the pavement in good condition. Time studies of work performed by street laborers working in gangs showed that work done by groups and gangs was not as economical as the division of such work through individual arrangements. Considerable time is lost in conversation. When one man rests every man on the street does the same thing. While working in gangs the good sweeper does no more work than the poorest of the gang. Where it is desired to cover a large area of street with men working in groups rather than in gangs it would be better, the Commission thinks, for each man to have a definite uniform area to cover and to require the foreman to time each individual.

Mr. Edward D. Very, Sanitary Engineer, says that any attempt to estimate the amount of materials which accumulate on a city street must end in failure as the contributing elements vary in different localities in a city and in

different cities, and where figures are given they do not really present any valuable data. Some general principles, however, have been determined. The Chicago Commission in its investigation declares that the quantity and volume of dirt attributed to horse drawn vehicle traffic is the most important source of street dirt. The loss of sand and coal and crushed stone, hay, manure and other loose material from poorly constructed vehicles or overloaded vehicles adds greatly to the quantity of street dirt to be removed. Important in a wet season is the dirt carried by moving vehicles through streets and alleys onto hard pavements, but the Commission says that the amount of dirt actually attributable to this source is considerably less than is usually believed. There is also considerable refuse in the form of leaves and grass which accumulates in the residential streets and along boulevards and parks, which has a tendency to lodge in catch basin inlets and stop the free flow of storm water. The quantity of leaves accumulating in the short leaf season on streets far exceeds that which naturally drops onto the surface of streets alone, because of the additional cleaning from lawns and parkway spaces.

Some reports express the belief that when a fixed standard is established of basing street cleaning schedules carefully on density of traffic, condition of pavement, character of frontage and kind of pavement, a definite relation will be found between the amount of street sweepings collected and the number of sweepers employed. In Chicago it has been found that different sweepers average daily collections of quantities varying from three-fourths of a cubic yard to three cubic yards. It has also been noted that street sweepings collected by regular block sweepers average about .0045 cubic feet per square yard. The weight of sweepings will, under ordinary conditions, approximate 36 pounds per cubic foot.

The paving and repair policy of a city is a very important factor in cleaning rates. Comparatively few cities

as yet give any thought when selecting a particular pavement as to the relative cost of keeping it clean. It is also a fact that in many cities repair work is neglected at the expense of cleaning.

A smooth, hard surface pavement will cost less to keep clean than one with a rough or uneven surface. A brick pavement, for instance, costs more to keep clean than sheet asphalt. For the same reason a street out of repair is more expensive to clean than one in good repair.

Officials agree that a paving policy should be carried out with a view to having a minimum number of unpaved approaches to existing pavements in order to prevent mud being tracked from the highway to pavement. There is need also of protecting narrow rural pavements from the overflow or tracking of mud that originates on adjacent portions of the same highway.

In a discussion of paving policies and their relation to street cleaning Mr. Hanna says: "The construction and maintenance of pavements that are easy to clean are important and effectual in saving the cost of street administration. Little weight is given to cleaning cost when paving questions are settled and an actual expense of $500 a mile in repairing residence streets would be considered an appreciable item of maintenance, yet that figure for cleaning a mile of residence streets through a season is extremely low. A street cleaner looks upon two qualities in a pavement. It must be smooth and particles of litter must not stick to the surface. The question of smoothness opens up the whole matter of durability. Any material that deteriorates or roughens becomes more difficult each year to clean. Any neglect of needed repairs means a larger cleaning bill until the repairs have been completed. The twofold expense resulting from wear, the cost of repairs plus the increased cost of cleaning should enter into all calculation of expense. Additional calculation of cleaning expense must be made for all bituminous pavements on ac-

count of the sticking of particles of litter to the surface. These surfaces are never quite so clean as non-adhesive materials and it costs from 25 per cent. upwards in additional cost to put them in a reasonably presentable condition on account of this quality. This difficulty is seen at its worst in a new creosoted wood block pavement, when the oil is gradually working out between the pores of the wood. The use of steel scrapers must often be employed as the flushing by water is not at all effective in removing the dirt from the surface.

"Substances most easily cleaned that enter into pavements are brick and stone. Neither originates any dirt, and both wash off readily. The only ground for discrimination between them is on the question of smoothness where brick has a slight advantage as a rule. In the use of these materials the choice of a filler is all important. A bituminous filler has all the disadvantages of a bituminous surface. Being softer than the brick or block it recedes, leaving a crevice that invites lodgment of dirt; with edges of brick or block unprotected it is sure to roughen, thus adding to the difficulties of cleaning. Such a street after a few years presents the appearance of cobble stones with the filler invisible or else melted and run to the gutter where it impedes work of follow-up gang."

Mr. Hanna recommends only a cement grout filler. He says that West 14th Street in Cleveland has a grouted brick pavement ten years old and a traffic of two vehicles a minute. It is cleaned on an average of five times a week, being flushed by night and hand swept by day. The cost of cleaning is almost exactly 15 cents per 10,000 of square feet. This is the lowest figure the city has been able to reach on any type of pavement. Mr. Hanna says that the cost on the best asphalt would not be less than 20 cents and would rise to 30 cents if the surface became wavy or rough. Wood block costs approximately $1.00 a square to clean in its initial condition, and it would be at least two years

before oil will have dried out sufficiently to admit its being cleaned for 30 cents a square. Tar filled brick pavement will cost not less than 30 cents a square, and if the filler disappears and the block roughens this cost will amount to 60 cents or more. In the case of a pavement 40 feet wide there are about 21 squares to a mile.

Thus Mr. Hanna points out that as between a material that can be cleaned for 15 cents and one that can be cleaned for 30 cents, there is a difference of $3.15 per mile for cleaning, a difference of $15.75 per week, or $630 per season of 40 weeks—$6,300 in ten years. In Mr. Hanna's judgment cleaning costs can be greatly reduced by a policy of prompt repair. He believes in the continual patrol of all city streets by men whose duty it is to discover defects in pavement and prescribe repair.

Schedule of Street Cleaning

The unit work must be established and the responsibility of each employee fixed in order to secure an economical administration of street cleaning. This principle is illustrated by the so-called "block system." By this, each man is allotted to a definite area of pavement to clean, which varies in extent depending upon local conditions as to traffic, physical condition of pavement, location of street, proximity to public buildings, population, paving, alleys, street cars, right of way and frontage of streets.

It is the practise of up-to-date cities to prepare schedules showing the character of pavement, area of pavement, number of cleanings or patrols per week, and the standard of work required of each street cleaner. Changes in these schedules are necessary from time to time on account of climatic conditions, street repair and other necessities. The Chicago Civil Service Commission says that to obtain definite standards of schedules for cleaning streets and alleys and the need of repairing such streets, the routing of teams

and vehicles, collecting of city waste, the amount and character and physical condition of all pavements must be obtained.

Pavements are usually classified according to physical character for the purpose of determining the amount and character of cleaning as follows:

Improved—Permanent (a) Smooth pavements, including asphalt, creosote block and bitulithic. (b) Rough pavements, including brick, granite, cobble and rubble and other pavements which require that dirt be picked from interstices.

Improved—Not permanent. All macadam pavements and country roads.

Unimproved pavements. All streets that have not been paved.

The oiling of macadam within the past few years has had an excellent effect on this kind of pavement and has given it the solidity and usefulness almost approaching improved permanent pavements. On macadam surface streets, periodical removal of rough material with hoes, brooms and shovels from street surface and gutters and sprinkling in dry weather with water or oil is about the best that can be done. An analysis in Chicago of the standard of work which one man can perform on an oiled macadam street, indicates that the rate of cleaning one and three-quarters miles of oiled macadam of average width in an eight hour day can be reasonably expected of any man.

Much waste is caused by lack of system in laying out the work and improperly directing the street cleaning gangs and teams. The attached tables give the systems now being used in fifty American municipalities. A study of these will show that some very definite ideas have been developed by street cleaning officials in this country. For example,

most cities prefer having patrolmen work singly instead of in gangs.

In making assignments attention should be given to the smallest details, such as correct reports from foremen as to the number of streets swept and loads carted away, and the correct number of sweepers in each street. In many cities three are sent through a street when two would do. Dirt wagons should not be started immediately behind sweeping gangs as it usually takes thirty minutes to an hour before a gang can sweep up enough dirt for a full load. Dirt teams should not start for at least one hour after the sweeper begins. Gangs should have allotted to them enough work to keep them busy until quitting time so that they do not have to kill time. Laxity in any part of the system eats up the department appropriation.

Spring Cleaning

The spring cleaning system usually calls for the piling up and removal of the heavy dirt which is washed from the center of the street and which accumulates in the gutters during the winter season. The experience of cities with such work indicates that the assignment of one man to a definite length of street, or the assignment of a small gang of not exceeding three men, to definite lengths of streets is more effective and economical.

The Chicago Commission says that where a gang of three men is assigned to the work, team work is developed by the use of one man in removing the dirt from the roadway and one man each from the gutters. In the granite and brick pavements considerably more brooming is necessary on the roadway. Granite, brick and cedar block pavements require that the dirt be scraped from the center of the street to the gutter before piling in the gutters can be commenced. The center cleaning rates per man in Chicago are given as follows:

	Car Track Sq. Yds. per Day	Outside Car Track Sq. Yds. per Day
Good Asphalt	16,500	18,500
Fair Asphalt	12,900	14,800
Poor Asphalt	9,200	11,100
Good Brick	4,400	5,500
Fair Brick	3,540	3,700
Poor Brick	1,850	2,960
Good Granite	4,400	5,550
Fair Granite	3,340	3,700
Poor Granite	1,850	2,220
Cobblestone	1,470	.....

The single gutter rates in miles per day per man are given as follows:

Times Cleaned per Week	Asphalt	Good Brick	Poor Brick and Granite of All Kinds
2	1.8 miles	1.4 miles	1.4 miles
3	1.4 miles	1.1 miles	0.7 miles
6	0.7 miles	0.5 miles	0.3 miles
9	.....	0.3 miles	0.2 miles
12	.....	0.2 miles	0.2 miles

Chicago has found that the unit cost of spring cleaning of macadam and cedar block streets of different physical condition is as follows:

First Class Condition, Cost for Cleaning 100 Lin. Ft.		Fair Condition, Cost for Cleaning 100 Lin. Ft.		Poor Condition, Cost for Cleaning 100 Lin. Ft.	
Traffic		Traffic		Traffic	
Heavy	Light	Heavy	Light	Heavy	Light
$1.18	$.90	$1.97	$1.46	$2.25	$1.89

Street Sprinkling

Although many cities sprinkle their streets for dust laying only, it is agreed by all experts and the heads of most street cleaning departments that the use of sprinkling carts for this purpose is of no value, *i. e.* it is a temporary makeshift and the result is nil. Sprinkling alone does not clean pavements, but only converts temporarily the fine dust into mud, which is a nuisance. It is quite generally

agreed, too, that sprinkling is responsible for much repair work on pavements.

The number of times a street is sprinkled daily depends upon weather conditions, nature of pavement and location, and rarely exceeds four trips. Where flushing and squeegeeing are done sprinkling is eliminated entirely.

In Providence, Rhode Island, bituminous pavements are not sprinkled by water. They are kept clean by patrol system and reasonably free from dust. It is the belief of officials of that city that the use of water has an injurious effect on the pavement.

George D. Warren, of Boston, an expert on paving, says that street sprinkling as it is generally practised is worse than a useless expense. He points to the fact that there has been no sprinkling in Providence in seven years on all kinds of pavement, except that water bound pavement is occasionally sprinkled with oil or oil emulsion. If bituminous pavement surfaces are dry and clean the oil which drips from automobiles is quickly spread by auto tires to an extremely thin sheet, which not only preserves the pavement, but the slight amount of oil takes up the fine dust and materially helps to prevent the surface from even becoming dusty.

Mr. Warren believes that while some forms of pavement are doubtless more affected by water and mud than others, sprinkling injuriously affects all classes of pavement. Continuing he says: "I believe that repairs required to all classes of pavement are more generally the result of wetting down the dirt, leaving the surface in a more or less muddy condition than by traffic, or rather what would be traffic under dry cleaning conditions. A city or street in or on which sprinkling or other methods of continual wetting of pavement surface has not been practised is almost usually one where the pavements are the best of their kind. Washington has the enviable reputation of having the most durable pavement of all kinds. For many years the system of clean-

ing there has been hand patrol without sprinkling, except a very light sprinkling, just enough to lay the dust, not to convert it into mud—immediately in advance of night sweeping.

"Fifth Avenue, New York, is always dry except during rains, and we find one of the most durable asphalt pavements in the world. The pavement is always clean and never dusty.

"Asphalt pavement on Alexander Street, Rochester, New York, laid in 1885, is still in existence and has a record for low cost of repairs, and has until quite recently been free from street sprinkling. It is now rapidly deteriorating.

"Rutger Street, in Utica, New York, laid in 1886, has been through a similar experience of no sprinkling. Michigan Boulevard in Chicago, from Jackson Boulevard to 10th Street, was paved partly with creosoted wood block and partly with asphalt. It was always in a dry condition and carried very heavy traffic for ten years and was in a good condition until about four years ago when it was removed on account of widening the street. The bituminous pavement on Michigan Boulevard is always clean and never cleaned or sprinkled other than by patrol cleaning, except as to narrow strips about four feet wide which are sprinkled and hand broomed at night to remove the slight dust which collects near the curb."

The Bureau of Municipal Research of Milwaukee reports that in that city 298 miles of street are sprinkled at a cost of $60,310.05. Of this amount $55,104.77 is assessable.

The balance is the city's portion for public property and street and alley sections which is charged to the general city fund. The city used 275,498,112 gallons of water, costing $28,416.65 including $8,800 for hydrant rental. The average rate of assessment per foot front is about .017c. In some cities where water is unavailable outside of city

limits, or available only for a short time, oil has been used to meet the demands for dust prevention. What seems to be the best is some non-volatile oil that will quickly penetrate the wearing surface of the road incorporating itself with the fine particles so that it forms a dense, smooth, waterproof coating, or else renders the surface dressing so heavy that wind will not hold it in suspension in the air. In addition to this its non-volatile character gives it lasting qualities.

The Milwaukee Bureau of Municipal Research believes that "The service at its best is of no value as it does not clean but only allays dust on the street where in its wet condition it requires a further process of cleaning by the squeegee or flusher and White Wings. If the city had a sufficient amount of modern equipment to clean streets more frequently, the valueless method of sprinkling could be eliminated and an enormous expense saved."

In some cities street railway companies are required to sprinkle between their tracks and for certain distances on either side of the track. The legal question has several times arisen, whether a Municipal corporation has authority to enact an ordinance to compel railway companies to sprinkle in this way and also whether the particular ordinance in question is reasonable, or so unreasonable as to be void. Generally speaking it has been decided that such an ordinance must be specific, not burdensome, and confined to the company's tracks, though in one case in Massachusetts, under the statutory powers conferred upon municipal authority, an ordinance requiring sprinkling from curb to curb was sustained. Courts have held that an ordinance providing that "each and every Company or Corporation operating street car lines within the limits of the city of ———— shall water their tracks so as to effectually keep the dust on the same laid," and provides a penalty for its violation, is neither indefinite nor wanting in uniformity.

The question of sprinkling streets before sweeping has

been discussed repeatedly. Following are the methods used in some cities:

New York.—Sprinkling before machines. No sprinkling before hand sweeping.

Chicago.—Sprinkling before sweeping. The Chicago Code of 1911 requires that street car companies shall keep well sprinkled with water in a manner satisfactory to the Commissioner of Public Works, all streets on which they maintain and operate their tracks. They are required to sprinkle such streets twice each day. By another section such street car companies shall clean such portions of streets as lie between the two outermost rails of such tracks and also every additional service as may be prescribed in any railway ordinance relating to or affecting any street.

Philadelphia.—The proposals and specifications for the cleaning of streets, roads, alleys, inlets and markets for 1915, contained the following provision: In addition to the cleaning by blockmen required under these specifications, all streets must be periodically cleaned by machines, the number of weekly cleanings being given in the classification of streets, the remaining machine work shall be done with machine brooms immediately preceded by sprinklers.

St. Louis.—Sprinkling before sweeping is very rarely done, except in the case of certain large sweeping machines used by the city.

Baltimore.—Sprinkles before sweeping.

Pittsburgh.—Principal thoroughfares including all streets in business district cleaned by machine sweepers. Water cart precedes sweeping machine. The cart must never be more than one block ahead of the sweeper.

Washington.—Superintendent of street cleaning gives his opinion that much more effective sweeping can be done without sprinkling and in hand patrol work where dirt is not allowed to collect in any considerable quantity is not necessary. In machine sweeping, however, he finds it necessary to sprinkle with a small amount of water. In cold weather sprinkling is omitted; but at such times many complaints are received on account of dust.

Minneapolis.—In general the orders of the street district commissioners are to sprinkle the streets before sweeping.

Street Cleaning Methods

Four methods are used in American cities for street cleaning, hand sweeping, machine sweeping, flushing by machine and hose and squeegeeing.

All experts advocate the sweeping of streets by hand, commonly called the patrol system. The implements used in patrol cleaning are broom, pan scraper, squeegees, can carrier and cans. The broom is usually one which has a 4 x 18 inch block, filled with split bamboo, rattan, hickory, steel wire or black African bass. The block is usually fitted with a steel scraper. The pan scraper is constructed like a dust pan, turned up sides and back. It is about 36 inches wide by 15 inches deep. The squeegee is a board about 36 inches wide fitted with a rubber strip which extends below the lower edge of the board. Brooms, pan scrapers and squeegees have handles about 66 inches long. The cans are made to hold about three cubic feet of dirt and taper 19 inches in diameter at the top to 17 inches at the bottom. The can carrier has two large wheels and two small, and a platform upon which the can or cans rest.

A new carrier has been devised which carries two cans and is so balanced that the two cans are more easily manipulated than the one. Some cities are now substituting canvas bags for cans.

Whinery says that when street surfaces are of such character as to admit it, hand sweeping is the most effective method.

J. W. Paxton says that hand cleaning work is capable of better distribution than any other method, because more attention can be given to dirtier areas by increasing the number of men who only clean the portions of the street which are dirty and work on those portions until they are clean. There is a fine scum which is not apparent when the pavements are dry but rises up in a thin sheet of mud when moist, making the pavements very slippery. This and fine dust cannot be removed by hand cleaners, but by washing about twice a week in addition to hand cleaning, these troubles can be eliminated.

Very believes that this method of cleaning is fairly effective but is a dust raiser and the ability of the man to cover areas is very limited, especially since the automobile has come into such general use, as it interferes with the sweeper and his work. He says that there are hand machine brooms built on the principle of the carpet sweeper which are not dust raisers and which as a matter of fact do much more effective work. The pan scraper is only valuable to remove manure and mud and coarse litter, and its use should be limited to the time necessary for such work, and the broom used for dust removal.

The area a sweeper can clean depends upon the existence of local conditions. A test was made in New York City for one week and it was found that the area one sweeper was able to clean in a day of eight hours varied from 2,212 square yards to 16,075 square yards, with an average over the whole city of 5,745 square yards. The efficiency division of the Civil Service Commission of Chicago reports: "From an analysis of the findings of the time and motion studies of street cleaners the following table has been deduced, upon which are based the relative difficulty of cleaning different pavements under varying

conditions and the standard and equivalent areas to be cleaned by one man in one eight-hour day.

Pavement	Condition	Square Yards
Asphalt	Good	21,500
Asphalt	Fair	19,300
Asphalt	Bad	17,200
Creosote Blocks	Good	21,500
Brick	Good	16,000
Brick	Fair	14,400
Brick	Poor	12,800
Granite	Good	13,400
Granite	Fair	12,100
Granite	Poor	10,700

In Philadelphia, which cleans its streets by contract, block men are assigned to sections designated by the chief. The area to be covered depends upon the character and amount of traffic. The duties of block men consist in patrolling the areas, gathering all papers and refuse and sweeping dirt as fast as it accumulates, and putting it into dust proof bags ready for loading into special wagons and hauling to a dumping station. The equipment used in hand patrol work consists of hand machines, bag carrier, burlap sacks, push brooms, hand scrapers, special cans and shovels. The dirt collected is placed in sacks and left at convenient points to be collected by special wagons and taken to the dump in sacks, these being returned by the drivers. Sacks are used in preference to cans because of the weight, bulk and noisiness of the latter.

Machine Sweeping

Machine sweeping and cleaning is almost universally condemned, although this method is used in many cities. The machine broom is preceded by a sprinkling cart to loosen the filth and in a measure to prevent the dust rising. This is seldom effected. A broom is found to cover about 40,000 square yards per eight hours. The material is swept into windrows at the side and finally delivered to a windrow in the gutter, where it is picked up. The efficiency of the

rotary broom system is considerably reduced because the sweepers meet continual obstructions in busy streets and when operating over paved streets the brooms remove the coarser fragments of dirt only and leave the finer particles on the pavement.

Where the rotary broom is preceded by a street sprinkler, the dust forms into mud and clings to the surface of the pavement, and where the pavement is rough the mud is forced into the joints between paving blocks. As the street becomes dry, the dirt pulverizes and appears again as a dust nuisance. In all but one instance machine sweepers have been dispensed with in Chicago. South Water Street, the heavy wholesale fruit district of the city, is badly congested during the day, which makes it impossible effectively to clean this district by the "block" system. This street becomes very dirty during the day and is covered with a thick layer of dirt and débris at night. In this instance, the broom machines appear to be effective and give fairly good results in the cleaning of this coarse material.

The Chicago Commission believes that the mixing of calcium chloride with the water which is sprinkled in the different sections of the city would greatly add to the effectiveness of street cleaning and eliminating the perils of dust.

According to Very horse drawn brooms of the rotary style are not as effective as the hand broom.

Whinery says, "Sweeping by power sweepers at intervals of one or more days, while less expensive is far less effective and satisfactory than hand sweeping, though if properly done and supplemented by sprinkling with water or oil at intervals sufficiently near together to prevent dust flying it serves a good purpose."

J. W. Paxton is of the opinion that the machine broom raises so much dust that heavy sprinkling is required. The fine dust mixed with water produces mud which is smeared on the street by the broom and when this becomes dry it

turns to dust again. The broom sweeps only the coarser particles and many of these are thrown over the broom by centrifugal force to the pavement again.

In Philadelphia, machine broom cleaning is done in batteries of two or three, preceded by sprinklers, the number of brooms in each battery depending upon the width and character of the streets to be cleaned. The average gang consists of two machine brooms and one sprinkler, and four to seven broomers and a sufficient supply of wagons to remove the refuse, the number depending upon the haul to the dump and season of year, together with amount and character of traffic.

An investigation made by the Milwaukee Bureau of Municipal Research into the cost of rotary broom service brought out the following facts: In industrial and outlying residential section and upon streets adjacent to wharfs, where pavements are constructed of brick, sandstone, limestone or granite, the rotary brooms are usually used. The process is done nightly and to prevent dust, a sprinkler is used in advance of broom.

The following analysis of the cost of operation has been made by the Bureau:

Cost of machine			$250.00
Depreciation of 10 per cent. on machine		$25.00	
Interest at 4½ per cent		11.25	
			$36.25
Minor repairs and replacements			
6 brooms at 50 lbs. bamboo	$20.00		
ea. at 8c. per lb	24.00		
48 hrs. labor @ 24¢ hr	12.00		56.00
			$92.25
150 days operation	$0.615		
2 sweepers at $2 per day ea	4.00		
Team and driver per day	5.00		
Grease, etc	0.05		
	$ 9.665		
Average yards cleaned, 40,000			
Average cost per 1,000 sq. yds., 24.1			
Combined with sprinkler			
Sprinkler, team per day	$5.00		
Water	0.90		5.90
40,000 sq. yds. sprinkled, cost per 1,000 sq. yds.			14.7
Broom cost per 1,000 sq. yds.			24.1
Combined cost per 1,000 sq. yds.			38.8

The assessment per front foot on a street 30 ft. wide and cleaned 50 times a season would be 3.2¢.

Pick-up Machines

To improve on machine sweeping various types of motor pick-up machines have been invented. Most of them have proved of no value. Some, however, are being used by cities with good results on dry, smooth pavement in good repair. Most experts question whether vacuum cleaning will ever be able to remove effectively mud or wet dust. Some experts, however, believe that these pick-up machines will solve the problem of cleaning macadam pavements, as it is the only method that can be employed without serious results. These machines will travel at a rate of four miles an hour, which exceeds the speed attained by any horse-power sweeper.

The experience of Oakland, Cal., with this method of cleaning is interesting. Adjacent to the congested district a suction sweeper had been used for several years. The district had been swept from three to six times a week, by contract, to the satisfaction of the city officials. The department reports that the cost was rather high in comparison with that for rotary sweeping, but that the results were more satisfactory. It cost the city 35c. per 1,000 square yards to clean with the suction sweeper and 26c. per 1,000 square yards with the rotary brooms. It had been generally assumed that the patrol system was the most expensive until the Street Commissioner readjusted the routes according to area and traffic. He then found that hand sweeping could be done on streets not swept by rotary brooms at the same cost or not to exceed a ten per cent. increase. He found also that it could be done for much less than cleaning by suction machines. The city has, therefore, entirely superseded this method of cleaning at an estimated annual saving of $3,000 and with much better results.

Pomona, California, found that moisture upon the sur-

face of a pavement or in any form of refuse cannot be lifted by a suction sweeper. Instead it is in effect smeared over the surface of the street. In all cases where the street is dry and the surface of the pavement is reasonably dry the city has found the machine very positive in its operation.

Los Angeles, California, is thoroughly testing the vacuum method of street cleaning following a report by the Efficiency Commission, which has estimated a saving of $65,071 a year if the streets are swept with vacuum cleaners instead of flushed. The report says that supplementary observations and calculations show that the cost of flushing under present conditions is 24.06c. per 1,000 square yards, and the cost of vacuum cleaning 10.96 cents per 1,000 square yards. These figures include the cost of supervision, maintenance of equipment, workman's compensation, gutter cleaning and water at cost of production. The cost of operating one of these machines is given by the Milwaukee Bureau of Municipal Research, as follows:

Purchase price			$4,000
Depreciation 50 per cent		$2,000	
Interest 4½ per cent		180	
		$2,180	
Repairs (estimated)		25	
Replacement of brooms, 30 @ $6 ea		180	
Labor making brooms		60	
Yearly cost		$2,445	
150 days operation, cost per day			$16.30
1 Chauffeur	$3.00		
2 sweepers	4.00		
1 ½ time	2.50		
Gasolene and oil	1.25		
Water	.12	$10.87	10.87
			$27.17

From personal observation it was calculated this machine can operate at a speed of four miles per hour and perform work at about 75 per cent. efficiency, or at a cost of 21.4c. per 1,000 square yards.

The assessment per front foot based on a street 30 feet wide and cleaned 50 times a season would be 1.77 cents.

Raymond W. Parlin, Deputy Commissioner Street Cleaning, New York City, says: "So definite are the needs of the cities for results better than those produced by sweeping that it may be safely prophesied that sweeping in the future will cease to be a primary method of cleaning a modern city and will become an auxiliary to other more efficient methods or used where only rough cleaning is desired."

Cleaning by Flushing

All authorities agree that whatever method for primary cleaning is adopted, it is important that the street surface be frequently washed by the use of hose, horse drawn flushers, flushing cars, or power squeegees. Reports from cities show that flushing is replacing machine sweeping and that the automobile flusher is becoming popular. The Chief of the Atlanta Sanitary Department favors doing away with sweeping machine and cleaning the streets entirely with flushing machines. He says that sweeping machines are out of date and that flushers are the ideal machines.

The squeegee is a vehicle having a tank and a revolving rubber roller, which washes the pavement as the vehicle moves along the street and the water from the tank is sprinkled in front of the roller. Hose flushing is used in cities having graded streets and sufficient water supply. Street flushers have pressure tanks which depend for their pressure either upon the pressure from the water mains or upon the pressure obtained from a pump operated by a gasolene engine. The latter plan gives the better results.

Whinery is of the opinion that on well paved streets the most efficient and satisfactory method so far devised with the apparatus now available is hand cleaning by the patrol system by day, followed with hose or flushing wagons or scrubbing squeegees during the night. While this is somewhat more expensive than plain machine sweeping he thinks that no other method yet devised will produce equally clean streets at a lower cost.

Gustave H. Hanna says: "The use of flushers has proven not only the cheapest but the most satisfactory method of street cleaning that our experience in Cleveland has been able to develop. Statistics of the department show an average cost of 15.3 cents per square of 10,000 square feet for flushing to which must be added practically 9 cents for pick-up work, a total of some 24 cents per square as against 42 cents for work with White Wings. The White Wings are too convenient and necessary an adjunct to be wholly displaced under any consideration. Down town streets must be swept continually during the day and the hand sweeper with his small cart can also work to advantage in gutters of residential streets collecting dirt that has either been flushed or blown to the curb; but so far as our experience goes, the lessening of cleaning cost by cheaper methods means simply the extension of the use of flushers at every practical point.

"There is an argument of sanitation in favor of flushing. Hand sweeping causes a certain amount of dust and mechanical sweeping usually causes still more. I am opposed to the use of simple sprinkling as a means of laying dust. Ammonia and other products leach out of damp manure and form a scum on the surface that is nearly impossible to remove, and makes pavement slippery and foul smelling.

"Water should also be applied with force enough to carry the refuse to gutter where it should be properly collected with broom and shovel and removed. In Philadelphia flushing machines are used only on poorly paved streets and block pavement. High pressure flushing machines are usually operated similarly."

Very reports that objection is made to flushing because materials are washed into sewers. The same objection, he says, might be made to hand sweeping, as many sweepers are like housemaids and sweep the dust into the catch

basins to make work easy. The material need not reach the sewers if the operator knows his business. Many fear that the action of water when used in flushing will wear away the pavement surface or the joint materials. His answer is that it should, if such a class of pavement or of jointing is allowed to be laid, to expose the paving contractor.

The Chicago Civil Service Commission says that personal inquiry and analysis of reports from cities using flushing machines seem to indicate that the use of flushing machines on rough and smooth pavement and the use of squeegees on smoother permanent pavements have given more effective cleaning than the ordinary block or gang cleaning where it is practicable to make the substitution.

The Milwaukee Bureau of Municipal Research, in its investigation of street cleaning in that city, says the contention of some is that flushing is detrimental to pavement as it removes grout, but such has not been proven in Milwaukee. The one fact that remains uncontradicted is that they clean the streets of every particle of débris and leave the thoroughfares in a sanitary condition; a matter of most vital importance.

In Milwaukee night work is confined to two territories comprising the heavy traffic and commercial territories and each alternating night the streets are flushed. This requires the use of four machines and they operate in a staggered double formation, cleaning the entire area without a return movement. When intersecting streets are encountered, the two rear machines perform the work and then return to the original function. A great deal more territory is thus covered than if machines were paired and each allotted a given area. Day work is performed in like manner except that the remaining four machines are assigned to outlying districts and confined thereto. The following is the cost of operating machine flushers as computed by the Bureau:

Cost of machine			$1,500.00
Fixed charges			
Depreciation of 10% on (wagon & tank)	$100.00		
Depreciation of 25% on engine	125.00		
Interest at 4½%	67.50		
		$292.50	
Maintenance			
Painting (each season)	20.00		
Hose and coupling, each season	15.00	35.00	$327.50
150 days operation—cost per day		$2.18	

In recommending the flushing process the Milwaukee Bureau says that sprinkling will be greatly reduced, the slippery surface of thoroughfares due to this valueless method will no longer exist, and that a cleaner and more sanitary condition will be the result.

The experience of Scranton, Pa., with flushers is that in going over the streets but once satisfactory results are not obtained. The director of public works says that this has also been found in other cities he has visited where flushers are used. He has concluded that the only practical and efficient way to clean streets is by the use of automobile flushers, one to about one and a half minutes ahead of the other, the first flusher dampening the horse droppings and other material that may stick to the pavement, thus loosening them, and the second flusher sweeping them into the gutter.

Birmingham, Alabama, reports that its experience has been that a great saving and better results are obtained by substituting street flushers for sprinklers and brooms.

Some cities are having success with street railway flushers, among them Cleveland, Scranton, Columbus and New Bedford, Mass. Cleveland furnishes and maintains the flusher cars, pays the cost of operating them, including the wages of employees and the cost of power, but contributes nothing toward fixed charges or for track maintenance or renewal.

Commissioner John T. Fetherston, of New York City, reports that the Mack truck flushing machines which the

city put into use during the summer of 1917 are capable, according to preliminary investigation, of cleaning from 100,000 to 120,000 square yards of street per machine per eight hour shift, and that they will do the work with the use of approximately 400 gallons of water per thousand square yards.

Hose Flushing

There is a difference of opinion as to the efficiency of flushing by hose. In Philadelphia all alleys and streets whose width between curbs is too narrow to permit the use of street brooms are cleaned once each week with hose. When additional cleaning is necessary it is done with hand brooms.

Very says that hose flushing is ineffective and uneconomical, and that water does not reach the pavement in such manner as to give full effect and usually is doing no work at all.

One city report makes this comment: "Four or five sweepers hold a hose and play it in some sections as though the object were to wash away the asphalt block pavement and car tracks. Target shooting, with a stream of water, so-called flushing, will never supplant wetting and scrubbing."

Very also claims that water to be effective must reach the pavement surface in a chisel shape and at a proper angle to remove and carry off the filth. He says that no man is properly constructed to hold the hose at a proper angle with the pavement to obtain the best results for any length of time. Commissioner Fetherston says New York's experience shows that a hose gang consisting of two men is able to clean well from 23,000 to 25,000 square yards of the dirtiest Belgian block pavement in eight hours, and will clean upward of 30,000 square yards of smooth pavement of modern granite block in the same time, using 2-inch hose, which is that city's standard size for use with its new

hose reels. The amount of water required to clean 1,000 square yards is approximately 1,000 gallons.

Cleaning by Squeegeeing

The squeegee method is used on smooth pavements. Batteries of two and three squeegees are usually preceded by sprinklers, which use as much water as possible without flooding the pavement, while the squeegees use just enough water to create a wash. The idea of sprinkling the pavement is to soften the surface and enable the squeegee to cleanse the street of slime as well as coarser material. Squeegees are followed by men who sweep up windrows of dirt into piles and a sufficient number of carts follow to remove the dirt. In New York where no sprinkling cart is used they average 50,000 square yards per machine per day with the use of 200 gallons of water per one thousand square yards. In Washington with a sprinkling cart they get about 80,000 square yards per machine per day.

Parlin says that squeegeeing produces very effective results with a limited use of water on smooth pavements in good repair.

Very believes that squeegee machines have their value, and if the sprinkler cart is used in advance better results are obtained.

In Milwaukee machines are in constant operation on smooth surface pavements. In certain sections where streets are exceptionally wide, three machines are used in staggered formation and necessitate but one and one-half complete trips over a street to perfect cleaning. They are routed in such a manner that little idle travel is necessary and filling plugs are specified to prevent empty haul to any great extent. The same system is applied to territories where only two machines can be operated, except that four return trips are necessary to complete the work. In no wise are operators allowed to confine their work within a given block unless conditions prevent, but must continue

until tanks are emptied, which usually occurs at end of second block. Two laborers are employed with these machines to keep gutters free from dirt and obstructing the water from flowing to the catch basins.

The average area cleaned in one year was 377,712 square yards at a cost of $96.35 per day or 25.5 cents per 1,000 square yards. Of the total yardage of pavement in the city 1,105,324 square yards are free from car tracks and subject to squeegee process. Some are squeegeed twice a week while others are cleaned but once and each have the additional service of White Wings and sprinkler.

The Milwaukee Bureau of Municipal Research gives the cost of squeegeeing as follows:

Cost of machine		$1,250.00
Fixed charges,		
Depreciation and repairs at 10% on machine	$111.00	
Depreciation & repairs at 50% on roller	70.00	
Interest at 4½%	56.25	237.25
Maintenance:		
Painting (each season)	20.00	
Hose and coupling (each season)	15.00	35.00
Season cost, $272.25		
150 days operation, cost per day	1.815	
Operation:		
Team hire per day	5.00	
One sweeper at $2	2.00	
Water at 6¢ per 1,000 gal	.82	
Cost per machine per day		$9.635

Manufacturers have placed on the market a modern motor driven squeegee said to be efficient and economical to a city with large area of smooth pavement. The capacity of this tank is increased to 750 gallons (an increase of 200 gallons over horse-drawn machine), which will permit a large area to be cleaned uninterrupted by constant filling, and reduce the lost time at hydrants. There are two sets of sprays, one directly in front of machine and one directly in front of squeegee. Back of the first spray or sprinkler head is a set of two brushes to loosen any hardened matter that might not be subjected to the squeegee process. By using this machine, the employment of laborers to con-

tinue the flow of water to catch basins is unnecessary, as the discharge of water is sufficient to remove any slight particles that are removed by the horse drawn equipment. At the end of the season, the machine can be dismantled and a box attached to make it available for other purposes. The cost of operating this style is estimated by the Milwaukee Bureau to be as follows:

Cost of machine			$4,000.00
Depreciation and repairs at 25% on machine (one-half chargeable to street cleaning)		$481.25	
Interest investment 4½% (one-half chargeable to street cleaning)		90.00	
One roller per season		85.00	
Maintenance:			656.25
Hose, couplings, 4 tires depreciation at 50%			
Replacement of two brushes		69.00	
Season cost			725.75
150 days operation on street cleaning	$4.84		
Operation:			
1 sweeper per day	$2.00		
1 chauffeur per day	3.00		
Gas and oil	1.82		
Water at 6¢ per gal	1.60		
	8.42		
Daily cost			13.26

Average square yards cleaned per day, 80,000
Cost square yards, 16.5¢
Assessment for foot front based on a street 30 feet wide and cleaned fifty times a season would be $1.37.

This cost data shows motor driven squeegees will perform twice the amount of work as horse drawn at a reduced unit cost. The difference in operating cost of two types would be

Horse drawn, average cost per 1,000 square yards	25.5¢
Motor driven, average cost per 1,000 square yards	16.5¢

Whinery says that while it is true that flushing methods, if thoroughly used, do carry the removed dust into the sewers or drains, which is regarded by many objectionable and to clog the pipes, this might happen where the whole of the street dirt, coarse and fine, is thus carried together into the sewers. He does not know of any instances where actual trouble has resulted. The practise of cleaning the streets wholly by squeegeeing or flushing is not, however, to be recommended, he believes, if for no other reason than

that it would be impracticable to do the work several times each day and thus prevent the formation and flying of dust. The danger of clogging the sewers by flushing dust only into them is, he thinks, very remote, as the quantity of the dust remaining after proper coarse cleaning is small. Careful determination by the New York Commission on Street Cleaning and Waste Disposal showed that on smooth pavements cleaned by the patrol system the accumulation of dust in 48 hours after the street has been washed either by hard rains or by flushing, does not exceed five per cent. or six per cent. of the total daily quantity of street dirt, though on rough stone block pavement it may be much larger. This quantity is so small that its disposal through the sewers could hardly cause serious trouble. In fact, the large volume of water used tends rather to flush and clean out the sewers.

In a paper read before the American Society of Municipal Improvements, Mr. Parlin summarizes as follows the results of a study made by him to determine the economy of the various types of flushing equipment: "Hose flushing on small areas was the most economical method; that up to 40,000 square yards, the horse drawn equipment was next in economy; that from 40,000 square yards to 90,000 square yards the hose was about as economical as the automobile; that from 90,000 square yards to 120,000 square yards automobile was supreme, and for daily schedule areas of over 120,000 square yards the automobile and street car equipment give nearly the same economy."

The street washing equipment of the future will probably be a combination affair. This has been used in Europe for several years. New York City is now developing combination equipment.

The ideal system of street cleaning would, therefore, be efficient patrol or hand cleaning through the day or during a longer period if the volume of travel in the evening re-

quires it, and thorough scrubbing with squeegees or washing with water under pressure by flushing machines or hose at night as often as may be necessary.

Although the automobile equipment has not been in use long, experience has shown that it is both efficient and economical, particularly in the larger cities.

Disposal of Street Refuse

In most cities the final disposal of sweepings and waste collected from the streets is a troublesome problem, and the cost is no small item in the expenses of the street cleaning department. The majority dispose of the sweepings on city dumps. A few cities are able to dispose of a part of the sweepings from paved streets to farmers and gardeners in the near vicinity on terms that repay at least a part of the cost that would otherwise have to be incurred, but the expense of handling and transporting the material to any considerable distance and its great bulk compared with its commercial value as a fertilizer place a limit on its disposal in this way. Nevertheless, it should be possible in the smaller cities at least to interest farmers and gardeners in the use of this material to a greater extent than is now common and to dispose thus of the sweepings at a price that would reduce the cost of disposal otherwise. The use of street refuse for filling low ground or reclaiming areas of shallow water and marshes has not been so seriously considered as it should be.

In some cities the street dirt is used as a fill between sidewalks and curb or in low alleys and vacant lots which are adjacent to the streets cleaned.

In other cities where the so-called "short haul" system is used, the street dirt is collected from stations at which the street sweepers deposit it, for filling purposes within the ward. The haul seldom exceeds three-quarters of a mile. One mile has been used as a standard for short hauls within wards.

Relative Cost of Street Cleaning

Most experts agree that little can be gained by comparing unit costs in different cities as local conditions and prices paid for labor, etc., vary so widely. Another reason is the lack of uniformity in standards and records maintained in the various cities. And still another reason is the varying standards of cleanliness. Very few cities in considering the sum to be appropriated first determine the standard of cleanliness to be attained. An investigation conducted by the United States Bureau of Census indicated that the unit cost of street cleaning in cities having less than 300,000 inhabitants is less than that in cities having over 300,000.

When the many different methods of record and cost keeping are considered as well as the difficulties encountered in obtaining accurate information as to conditions and methods used in the cleaning of streets, the reasons for these differences are apparent.

The Municipal Journal in January, 1915, printed a table which shows that the average number of cleanings per year in thirty-one of the largest cities was 156, varying from 37½ to 300. The cubic yards of sweepings per year per thousand square yards of street area averaged 20.5, varying from 5.7 to 48; the latter being in Boston and nearly four times that reported from Washington. The average amount of sweepings collected at each cleaning was 191 cubic yards per million square yards cleaned, varying from 32 to 440. The cost per thousand square yards of cleaning done averaged 35½ cents, varying from 14 cents to $1.53. The cost per cubic yard of sweepings averaged $2.70, varying from 79 cents to $8.75.

Table

STREET CLEANING

Name of City	Population	Miles of Streets Swept per Year			Area in Square Yards Hand Sweeping	
		By Hand	By Machine	Total	Smooth	Rough
Buffalo, N. Y.	461,335	9,600	34,000	.....	.....	.....
Beacon, N. Y.	10,165	1.5	.....	.....	.....	.....
Binghamton, N. Y.	53,000	2	25.6	27.6	.....	.....
Cincinnati, Ohio	402,175	20,112	10C	.....	.....	254,951
Cambridge, Mass.	110,000	15	108.5	.....	.....	.....
Chicago, Ill.	2,200,000	4,674,396,308 S.Y.	12,039,859 S.Y.	.....	19,841,482	7,551,053
Camden, N. J.	95,000	.....	.....	2,249,314	.....	.....
Columbus, Ohio	220,000	.....	.....	.....	.....	.....
Cleveland, Ohio	561,000	.....	.....	.....	.....	.....
Cortland, N. Y.	13,000	6	.....	.....	.....	.....
Dunkirk, N. Y.	17,870	.....	.....	26	.....	.....
Denver, Col.	245,523	102,501,230 S.Y.	.....	215,046,848 S.Y.	.....	.....
Elmira, N. Y.	40,093	.....	.....	20.672	41,000	.....
Fall River, Mass.	124,791	.....	.....	.....	.....	.....
Grand Rapids, Mich.	131,000	.....	.....	.....	.....	.....
Hudson, N. Y.	13,000	.....	.....	21.5	.....	.....
Jamestown, N. Y.	38,000	1	30	.....	.....	.....
Kansas City, Mo.	319,000	.....	.....	462.65F	.....	.....
Kingston, N. Y.	27,000	4	.....	.....	.....	.....
Los Angeles, Cal.	550,000	333	.....	.....	.....	.....
Louisville, Ky.	224,000	.....	.....	8,331	.....	.....
Lowell, Mass.	106,294	.....	.....	.....	.....	.....
Lynn, Mass.	96,000	.....	.....	35	.....	.....
Lackawanna, N. Y.	17,500	.....	5.5	.....	.....	.....
Little Falls, N. Y.	13,000	6	.....	.....	74,000	5,000
Milwaukee, Wis.	450,000	82	252.5	.....	.....	.....
Middletown, N. Y.	18,000	4.2	.....	.....	88,235	.....
Mechanicville, N. Y.	8,208	5.	.....	.....	.....	.....
New York City (Manhattan, Bronx & Brooklyn)	4,551,860	.....	.....	1,487	.....	.....
New Orleans, La.	400,000	.....	.....	.....	.....	.....
New Bedford, Mass.	111,000	.....	.....	.....	.....	.....
Newark, N. J.	370,000	.....	.....	.....	.....	.....
Norwich, N. Y.	8,500	.....	6	.....	.....	.....
New Rochelle, N. Y.	35,500	58	.....	.....	4.67 Mi.	47.1 Mi.
Niagara Falls, N. Y.	45,000	.....	400	.....	.....	.....
Newburgh, N. Y.	27,876	.....	.....	.....	.....	.....
Oakland, Cal.	215,000	4,128	5,160	.....	.....	.....
Oswego, N. Y.	24,000	.....	90	.....	.....	.....
Ogdensburg, N. Y.	14,388	1-3	10	.....	.....	.....
Philadelphia, Pa.	1,800,000	461	1,165	.....	750,139	.....
Providence, R. I.	248,000	.....	.....	.....	.....	.....
Rochester, N. Y.	248,465	.....	.....	258.171	.....	.....
Rensselaer, N. Y.	11,112	.....	.....	.....	.....	.....
Reading, Pa.	110,000	.....	.....	209,659 squares	.....	.....
Richmond, Va.	160,000	.....	.....	.....	.....	.....
St. Louis, Mo.	835,000	.....	.....	405	.....	.....
San Francisco, Cal.	500,000	.....	.....	460	.....	.....
Salt Lake City, Utah	120,000	30	.....	54	.....	.....
Springfield, Mass.	102,971	.....	.....	.....	.....	.....
Seattle, Wash.	238,000	.....	.....	.....	.....	.....
Scranton, Pa.	130,000	.....	.....	.....	.....	.....
Troy, N. Y.	76,000	.....	40.89	.....	.....	.....
Utica, N. Y.	85,000	.....	½ sq. mi. daily	.....	.....	.....
Washington, D. C.	360,000	.....	.....	.....	.....	.....

I (a)

IN AMERICAN CITIES

YARDS SUBJECT TO CLEANING

Hand Sweeping			Machine Sweeping				
Macadam	Total	Smooth and Rough	Smooth	Rough	Macadam	Total	Smooth and Rough
.....	749,600	.....	.....	.....	.....	7,964,500	.....
.....	.....	26,400	.....	.....	.....	.....	.....
.....	114,829	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....
.....	350,000	.....	.....	.....	.....	1,250,000	.....
6,605,237	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....
.....	9,150,000	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....
3,000	.....	.....	.....	.....	.....	.....	.....
.....	1,600,170	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	28,429,785	.....	.....	.....	.....	10,391,283
.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....
6.3 Mi.	.....	.....	.....	.....	.....	25,000	.....
.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....
7,333,000	.....	180,800	.....	.....	187,851	.....	.....
.....	.....	412,866	.....	.....	.....	.....	778,374
.....	.....	.....	.....	.....	.....	.....	.....
3,835,217	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....
.....	56,820,400	.....	.....	.....	.....	208,031,600	.....
.....	.....	.....	.....	.....	.....	.....	.....
.....	525,105,551	.....	.....	.....	.....	65,228,812	.....
.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....
.....	3,521,624	.....	.....	.....	.....	12,324,340	.....
.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	727,112	53,542	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....
1,513,562	.....	6,682,766	.....	.....	.....	.....	1,584,524

Table

STREET CLEANING IN

Name of City	Area in Square Yards Subject to Cleaning			
	Hand and Machine Sweeping			
	Smooth	Rough	Macadam	Total
Buffalo	.....	.....	.....	8,714,100
Beacon	.....	.....	.....	.....
Binghamton	.....	.....	.....	.....
Cincinnati	.....	651,213	4,981,710	.....
Cambridge	.....	.....	.....	35,000
Chicago	.....	.....	.....	33,466
Camden	.....	.....	.....	.....
Columbus	.....	.....	.....	.....
Cleveland	.....	.....	.....	.....
Cortland	.....	.....	.....	.....
Dunkirk	.....	.....	.....	.....
Denver	.....	.....	.....	.....
Elmira	.....	.....	.....	.....
Fall River	.....	.....	.....	.....
Grand Rapids	.....	.....	.....	.....
Hudson	.....	.....	.....	.....
Jamestown	.....	.....	.....	.....
Kansas City	.....	.....	.....	.....
Kingston	.....	.....	.....	.....
Los Angeles	.....	.....	.....	.....
Louisville	.....	.....	.....	.....
Lowell	.....	.....	.....	.....
Lynn	.....	.....	.....	.....
Lackawanna	.....	.....	.....	.....
Little Falls	.....	.....	.....	.....
Milwaukee	.....	.....	.....	.....
Middletown	.....	.....	.....	.....
Mechanicville	.....	.....	.....	.....
New York City	.....	.....	.....	.....
New Orleans	.....	.....	.....	.....
New Bedford	141,098.22	98,843.03	.....	.....
Newark	.....	.....	.....	.....
Norwich	.....	.....	.....	.....
New Rochelle	.....	.....	.....	.....
Niagara Falls	.....	.....	.....	.....
Newburgh	.....	.....	.....	.....
Oakland	.....	.....	.....	.....
Oswego	.....	.....	.....	.....
Ogdensburg	.....	.....	.....	.....
Philadelphia	.....	.....	.....	.....
Providence	.....	.....	.....	.....
Rochester	.....	.....	.....	.....
Rensselaer	.....	.....	.....	.....
Reading	.....	.....	.....	.....
Richmond	.....	.....	.....	264,852,000
St. Louis	.....	.....	.....	.....
San Francisco	.....	.....	.....	590,394,363
Salt Lake City	.....	.....	.....	.....
Springfield	.....	.....	.....	.....
Seattle	.....	.....	.....	15,845,994
Scranton	.....	.....	.....	.....
Troy	.....	.....	.....	.....
Utica	.....	.....	.....	.....
Washington	.....	.....	.....	.....

I (b)

AMERICAN CITIES (Continued)

AREA IN SQUARE YARDS SUBJECT TO CLEANING

	Sweeping and Flushing					
Smooth and Rough	Smooth	Rough	Macadam	Total	Smooth and Rough	Total
.....	.....	.....	.....	187,400 L	.....	.....
.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	71,804.4	.....	.....
.....	1,272,846	2,963,948	.....	.....	.....	10,124,668
.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	8,339,014 H	.....	.....
.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	172,226
.....	.....	.....	.....	.....	.....	316,601
.....	.....	.....	.....	.....	.....	.....
.....	429,442 L	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	62,474,499 L	.....	.....
.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	531,582
.....	.....	.....	.....	.....	.....	7,526,762 G
.....	.....	.....	.....	8,000,000 A	.....	.....
.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	100,000
.....	.....	.....	.....	6,375,676 J	.....	.....
.....	.....	.....	.....	.....	.....	.....
10,391,283	.....	.....	.....	.....	10,280,982	.....
.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....
.....	900,000	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	174,830
.....	.....	.....	.....	.....	.....	75,000
.....	.....	.....	.....	17,335,027	.....	.....
.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	4,265,061
.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	2,846,000L	.....	267,698,000
.....	.....	.....	.....	704,240,828	.....	9,427,212
.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	189,038,712	.....	.....
.....	301,878L	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	2,671,963H	.....

Table

STREET CLEANING IN

City	Square Yards Cleaned per Week						
	Hand Sweeping					Machine Sweeping	
	Smooth	Rough	Macadam	Total	Smooth and Rough	Smooth	Rough
Buffalo	.....	.....	.....	8,714,100D	.....	.....	.....
Beacon	.....	.....	.....	.....	.....	.....	.....
Binghamton	.....	.....	.....	.....	.....	.....	.....
Cincinnati	.....	.....	.....	5,747,174	.....	.....	.....
Cambridge	700,000	.....	.....	.....	.....	100,000	.....
Chicago	119,048,802	45,306,308	39,631,422	.....	.....	.....	.....
Camden	.....	.....	.....	.....	.....	.....	.....
Columbus	.....	.....	.....	.....	.....	.....	.....
Cleveland	.....	.....	.....	.....	.....	.....	.....
Cortland	.....	.....	.....	.....	.....	.....	.....
Dunkirk	.....	.....	.....	.....	.....	.....	.....
Denver	.....	.....	.....	.....	.....	.....	.....
Elmira	.....	.....	.....	.....	.....	.....	.....
Fall River	.....	.....	.....	.....	.....	.....	.....
Grand Rapids	.....	.....	.....	.....	.....	.....	.....
Hudson	.....	.....	.....	.....	.....	.....	.....
Jamestown	.....	.....	.....	.....	.....	.....	.....
Kansas City	.....	.....	.....	.....	.....	.....	.....
Kingston	.....	.....	.....	.....	.....	.....	.....
Los Angeles	B	B	B	.....	.....	.....	.....
Louisville	.....	.....	.....	.....	.....	.....	.....
Lowell	.....	.....	.....	.....	.....	.....	.....
Lynn	.....	.....	.....	.....	.....	.....	.....
Lackawanna	.....	.....	.....	.....	.....	.....	.....
Little Falls	.....	.....	.....	.....	.....	.....	.....
Milwaukee	.....	.....	.....	4,742,044MM	.....	.....	.....
Middletown	.....	.....	.....	.....	.....	.....	.....
Mechanicville	.....	.....	.....	.....	.....	.....	.....
New York City	.....	.....	.....	.....	539,611,598	.....	.....
New Orleans	.....	.....	.....	.....	.....	.....	.....
New Bedford	.....	.....	.....	.....	.....	.....	.....
Newark	.....	.....	.....	11,754,257	.....	.....	.....
Norwich	.....	.....	.....	.....	.....	.....	.....
New Rochelle	.....	.....	.....	.....	.....	.....	.....
Niagara Falls	.....	.....	.....	.....	.....	.....	.....
Newburgh	.....	.....	.....	.....	180,800	.....	.....
Oakland	.....	.....	11,480,833D	2,477,196	.....	.....	.....
Oswego	350,000	.....	.....	.....	.....	264,717	.....
Ogdensburg	.....	.....	.....	.....	.....	.....	.....
Philadelphia	.....	.....	3,835,217	.....	.....	.....	.....
Providence	.....	.....	.....	.....	.....	.....	.....
Rochester	.....	.....	.....	.....	.....	.....	.....
Rensselaer	.....	.....	.....	.....	.....	.....	.....
Reading	.....	.....	.....	.....	.....	.....	.....
Richmond	.....	.....	.....	.....	.....	.....	.....
St. Louis	.....	.....	.....	.....	.....	.....	.....
San Francisco	.....	.....	75,015,076	.....	.....	.....	.....
Salt Lake City	.....	.....	.....	.....	.....	.....	.....
Springfield	.....	.....	.....	.....	.....	.....	.....
Seattle	.....	.....	.....	.....	.....	.....	.....
Scranton	.....	.....	139,377,763D	.....	.....	.....	.....
Troy	.....	.....	.....	.....	.....	1,453,224	107,086
Utica	.....	.....	.....	.....	.....	.....	.....
Washington	.....	984,000	.....	21,772,596	.....	.....	.....

I (c)

AMERICAN CITIES (Continued)

Square Yards Cleaned per Week

Machine Sweeping			Hand and Machine Sweeping		Sweeping and Flushing			
Macadam	Total	Smooth and Rough	Total, Smooth Rough and Macadam	Smooth and Rough	Smooth	Total, Smooth Rough and Macadam	Smooth and Rough	Total
.....	511,111,111D	.....	519,825,210D	.....	.....	5,622,000DL	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	53,276	.....	.....	.....	.....	4,617,277	.....	10,417,677
.....	.....	.....	230,796	.....	.....	50,084,064	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	1,679,593
.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	10,000,000A	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	100,000
.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	17,300,158	.....	17,300,158	.....	.....	5,273,638	562,184,394
.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	7,743,792
.....	.....	.....	.....	.....	18,000	.....	.....	.....
.....	.....	3,449,606	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	566,532	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	59,238,912	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	4,265,062
.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....
9,326,973	.....	84,342,051	.....	.....	100,605,832	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....
27,844,483D	.....	.....	.....	.....	236,000LD	.....	.....	.....
.....	.....	.....	.....	1,811,268L	.....	.....	.....	.....
.....	789,000	.....	.....	.....	.....	782,000H	.....	.....

Table

STREET CLEANING IN

City	Cubic Yards of Street Sweeping							
	Hand Sweeping					Machine Sweeping		
	Smooth	Rough	Macadam	Total Smooth, Rough and Macadam	Smooth and Rough	Smooth	Total Smooth, Rough and Macadam	Smooth and Rough
Buffalo	.....	.....	.....	.....	.....	.....	.....	.....
Beacon	.....	.....	.....	.....	.....	.....	.....	.....
Binghamton	.....	.....	.....	.....	.....	.....	.....	.....
Cincinnati	.....	.....	.....	.....	.....	.....	.....	.....
Cambridge	500	.....	.....	.....	.....	500	.....	.....
Chicago	9,329	5,428	1,558	.....	.....	.....	288	.....
Camden	.....	.....	.....	.....	.....	.....	.....	.....
Columbus	.....	.....	.....	10,586D	.....	.....	27,348D	.....
Cleveland	.....	.....	.....	.....	.....	.....	.....	.....
Cortland	.....	.....	.....	.....	.....	.....	.....	.....
Dunkirk	.....	.....	.....	.....	.....	.....	.....	.....
Denver	.....	.....	.....	.....	.....	.....	.....	.....
Elmira	.....	.....	.....	.....	.....	.....	.....	.....
Fall River	.....	.....	.....	.....	.....	.....	.....	.....
Grand Rapids	.....	.....	.....	.....	.....	.....	.....	.....
Hudson	.....	.....	.....	.....	.....	.....	.....	.....
Jamestown	.....	.....	.....	.....	.....	.....	.....	.....
Kansas City	.....	.....	.....	.....	.....	.....	.....	.....
Kingston	.....	.....	.....	.....	.....	.....	.....	.....
Los Angeles	.....	.....	.....	.....	.....	.....	.....	.....
Louisville	.....	.....	.....	.....	.....	.....	.....	.....
Lowell	.....	.....	.....	.....	.....	.....	.....	.....
Lynn	.....	.....	.....	.....	.....	.....	.....	.....
Lackawanna	.....	.....	.....	.....	.....	.....	.....	.....
Little Falls	.....	.....	.....	.....	.....	.....	.....	.....
Milwaukee	.....	.....	.....	75,423NN	.....	.....	.....	.....
Middletown	.....	.....	.....	.....	.....	.....	.....	.....
Mechanicville	.....	.....	.....	.....	.....	.....	.....	.....
New York City	.....	.....	.....	.....	.....	.....	.....	.....
New Orleans	.....	.....	.....	.....	.....	.....	.....	.....
New Bedford	.....	.....	.....	.....	.....	.....	.....	.....
Newark	2,001	1,500	388	.....	.....	.....	.....	.....
Norwich	.....	.....	.....	.....	.....	.....	.....	.....
New Rochelle	.....	.....	.....	.....	.....	.....	.....	.....
Niagara Falls	.....	.....	.....	.....	.....	.....	.....	.....
Newburgh	.....	.....	.....	48	.....	.....	.....	.....
Oakland	.....	.....	31,276D	.....	170	.....	.....	288
Oswego	.....	.....	.....	.....	.....	.....	.....	.....

I (d)

AMERICAN CITIES (Continued)

Removed per Week			Number of Weeks in Cleaning Season	Average Number of Cleanings per Week
Sweeping and Flushing				
Total Smooth, Rough and Macadam	Smooth and Rough	Total		
.....	.....	.....	35 to 40 for hand sweeping, machine sweeping, and hand and machine sweeping. 25 for flushing. This is for all kinds of pavement.	6 for hand sweeping all kinds of pavement, 2 for machine sweeping all kinds of pavement, and one for sweeping and flushing all kinds of pavement.
.....	.....	.....	35 weeks in cleaning season.	6 times.
.....	.....	.....	27 for hand sweeping, smooth and rough, 29 for machine sweeping, smooth and rough, and 32 for sweeping and flushing, smooth and rough.	6 for hand sweeping all kinds of pavement, 6 for machine sweeping smooth and rough, and sweeping and flushing, smooth and rough.
.....	.....	2,496	52 weeks.	Business daily, residential one to two times a week.
.....	.....	.....	52 for hand sweeping smooth pavement, 10 for machine sweeping smooth pavement.	Six for hand sweeping smooth pavement, 2 to 3 times a year for hand sweeping rough and macadam.
.....	.....	.....	36 for hand sweeping all kinds of pavement.	Six for hand sweeping smooth and rough, and three for hand sweeping macadam.
.....	.....	14,871D	.....	.....
12,284LD	.....	.....	.....	.....
.....	.....	.....	.....	.....
.....	.....	.....	32 weeks.	Six for hand sweeping smooth, and one for hand sweeping macadam.
.....	.....	.....	.....	6 times.
.....	.....	58,214D	52 weeks.	.....
.....	.....	.....	40 weeks.	Seven for hand sweeping smooth, and 2 for flushing rough, and one for flushing macadam.
.....	.....	.....	52 weeks.	Nine for hand sweeping smooth and rough.
.....	.....	.....	.....	.....
.....	.....	.....	.....	Six for hand sweeping rough, and 3 or 4 times a year for machine sweeping smooth.
.....	.....	90	27 weeks.	4½ times.
.....	.....	.....	52 weeks for hand sweeping all kinds of pavement, and 6 times a month for sweeping and flushing all kinds of pavement.	Business section 35, semi-business 7, and residential section one.
.....	.....	.....	.....	.....
.....	.....	1,500	52 for hand sweeping and for flushing all kinds of pavement.	5 times daily for congested and once daily for residential hand sweeping all kinds of pavement. 3 times daily for congested, and one and one-half times daily for residential flushing all kinds of pavement.
.....	.....	.....	52 weeks.	.....
.....	.....	.....	52 weeks.	.....
.....	.....	.....	52 weeks.	Business section twice a day; residential section once a week.
.....	.....	.....	32 weeks.	.....
.....	.....	.....	32 weeks.	Six for hand sweeping all kinds of pavement.
.....	.....	.....	Varies.	From one to six, depending upon districts.
.....	.....	.....	32 weeks.	41,300 S. Y. daily; balance twice a week.
.....	.....	.....	From 30 to 35.	6 times for hand sweeping smooth.
.....	.....	15,625	52 for hand sweeping, machine sweeping, hand and machine sweeping, and sweeping and flushing smooth and rough pavements.	Nineteen for hand sweeping smooth and rough, 27 for eight months for machine sweeping smooth and rough; number for hand and machine sweeping and sweeping and flushing smooth and rough depends on weather.
.....	.....	.....	52 weeks.	Six, excluding rainy days.
.....	.....	.....	42 for hand and machine sweeping smooth and rough.	.....
.....	.....	.....	52 for hand sweeping all kinds.	2 for hand sweeping all kinds.
.....	.....	.....	25 weeks.	Once a week.
.....	.....	72	52 weeks.	Six times a week.
.....	.....	150	30 weeks.	Sweeping and flushing smooth once.
.....	.....	.....	34 weeks.	Twelve times for hand sweeping smooth and rough.
.....	.....	.....	All cleaning continuous with reduced force on rainy days and irregular force on macadam cleaning. No machine sweeping on rainy days, which are equal to five to ten weeks a year.	Six times for hand sweeping smooth and rough, from one to four times per year for hand sweeping macadam, four times for machine sweeping smooth and rough.
.....	.....	.....	36 times for hand sweeping all kinds of pavements; 36 times for machine sweeping smooth pavement, and 30 times for sweeping and flushing rough pavement.	.....

Table I (d)

STREET CLEANING IN

City	Cubic Yards of Street Sweeping							
	Hand Sweeping					Machine Sweeping		
	Smooth	Rough	Macadam	Total Smooth, Rough and Macadam	Smooth and Rough	Smooth	Total Smooth, Rough and Macadam	Smooth and Rough
Ogdensburg	.....	.....	.....	.....	.....	.....	.....	.....
Philadelphia	.....	.....	51,961D	.....	.....	.....	.....	.....
Providence	.....	.....	.....	.....	.....	.....	.....	.....
Rochester	.....	.....	.....	.....	.....	.....	.....	.....
Rensselaer	.....	.....	.....	.....	.....	.....	.....	.....
Reading	.....	.....	.....	.....	.....	.....	.....	.....
Richmond	.....	.....	.....	.....	.....	.....	.....	.....
St. Louis	.....	.....	.....	.....	.....	.....	.....	.....
San Francisco	.....	.....	.....	.....	.....	.....	.....	.....
Salt Lake City	.....	.....	.....	24 a day	.....	.....	.....	.....
Springfield	.....	.....	.....	.....	.....	.....	.....	.....
Seattle	.....	.....	.....	.....	.....	.....	.....	.....
Scranton	.....	.....	.....	.....	.....	.....	.....	.....
Troy	.....	.....	.....	.....	.....	.....	.....	.....
Utica	.....	.....	.....	.....	.....	.....	.....	.....
Washington	.....	.....	8,602	.....	63,242	.....	.....	29,089

(Continued)

AMERICAN CITIES (Continued)

Removed per Week			Number of Weeks in Cleaning Season	Average Number of Cleanings per Week
Sweeping and Flushing				
Total Smooth, Rough and Macadam	Smooth and Rough	Total		
.....	.....	.....	.....	Streets not paved 2 cleanings a year; sections most traveled cleaned with sweeper twice during summer season also. Patrol system in business section also flushed twice a week.
.....	377,345D	.....	52 for hand sweeping and 45 for machine sweeping all kinds of pavements	One for hand sweeping macadam, from two to six for machine sweeping smooth and rough, and sweeping and flushing all kinds of pavement.
.....	.....	.....	52 times for hand sweeping smooth, 8 times a month for hand sweeping macadam and machine sweeping rough.	Six times for hand sweeping smooth; 6 times a year for hand sweeping macadam, and once for machine sweeping rough.
.....	.....	.....	.....	Rough swept by hand 3 to 6 times a week; macadam swept by hand once a week; rough machine swept from once to three times a week. Smooth swept and flushed 3 to 6 times a week.
.....	.....	.....	27 weeks.	From once to twice a week.
.....	.....	.....	.....	Twice a week.
.....	.....	.....	.....	.....
.....	.....	1,000 a day	52 weeks.	Business daily, residential once a week.
.....	.....	K	52 weeks.	Once.
.....	.....	.....	10 a month hand sweeping smooth, 3 times a year hand sweeping macadam.	.....
.....	.....	.....	.....	.....
.....	.....	.....	52 weeks.	Business six, semi-business 3, residential from one to two.
.....	.....	.....	.....	.....
.....	.....	.....	33 for machine sweeping macadam, and 33 for hand and machine sweeping smooth; 33 for sweeping and flushing rough.	Two for machine sweeping macadam and rough; 6 for flushing smooth.
.....	.....	.....	32 weeks.	From 3 to 6.
.....	.....	.....	52 for hand sweeping, machine sweeping and flushing and sweeping all kinds of pavements.	Six for hand sweeping smooth and rough; 2 for hand sweeping macadam, 3 for machine sweeping smooth and rough, and 2 for sweeping and flushing smooth and rough.

Table

STREET CLEANING IN

City	Force								
	Number of Foremen and Inspectors	Wage and Hours Daily*	Number of Mechanics and Skilled Laborers	Wages and Hours Daily*	Number of Teams	Cost and Hours Daily*	Number of Unskilled Employees	Wage and Hours Daily	All Others Employed
Buffalo	22	$2.50–3.00	19	$2.50–4.00	100	$4.00	139	$2.00	
Beacon	1						3	1.75	
Binghamton	1	3.00			7	4.50	18	2.00	
Cincinnati	8	20.00 Wk.	10	3.50–3.00	60	2.19	261	2.25–2.75	6
Cambridge	2	2.75			8	City teams	40	2.50	
Chicago	112	2.60–2.85			165	6.00	1,800	2.35	
Camden	1	93.32 Mo.			12		20		
Columbus									
Cleveland									
Cortland	1	1.75			3 single	2.50	4	1.75	
Dunkirk									
Denver	4	75.00 Mo.	3	2 50	40	5.00	70	2.50	
Elmira	1	2.50			5 double 1 single	4.00 double 3.00 single	12	1.75	
Fall River	1	3.50			4	3.75	57	2.40	
Grand Rapids									
Hudson									
Jamestown					2	5.50	8	2.00	
Kansas City	24	75.00 Mo.	3	3.00–3.50	30	5.00	225	2.25	18
Kingston									
Los Angeles	1	100.00–125.00 Mo.	2	3.00–3.50	89	5.00	333	2.50	
Louisville	25	2.00–3.00 9 hrs.			66	4.00 9 hrs.		1.75	
Lowell						7.50		2.25	
Lynn	1	3.20			2	5.38	26	2.50	
Lackawanna	10	2.50–3.00	10	2.75–3.25	4	4.75	35	1.85	3
Little Falls	1	2.00			1	4.50	7	1.75	
Milwaukee	27	1,000.00–1,900.00 Yr.		.45c. hr.		5.00		2.00	
Middletown	1	2.25			1	3.50	4	2.00	
Mechanicville	1	2.25				4.00	55	1.60	2
New York City	134	1,212.00–1,380.00 Yr.		$3.00–3.50		5.00		2.50	
New Orleans	27	75.00 Mo., 9 hrs.			93	City teams	340	2.00	
New Bedford	1	3.50			2		65	2.25	
Newark	15	3.33			35 double 34 single	4.80 double 3.20 single	300	10.00 Wk.	
Norwich					2–6	5.00	4–6	1.60	
New Rochelle						5.50			
Niagara Falls	6	3.00			30	5.00	50	2.00	
Newburgh			1	80.00 Mo.	1 single 1 double 3 hrs. day	2.75 single 75c. hr. double	18	2.00	
Oakland	2	110.00 Mo.			2	6.00	37	2.50	E
Oswego					4–6	4.00–5.60		1.60–2.00	
Ogdensburg	2	2.00–2.50	2	2.50		4.00		1.75	
Philadelphia	80	2.50 9–10 hrs.			229	5.50 9–10 hrs.	1,020–1,140	1.75 9–10 hrs.	
Providence	8				47	3.00 9 hrs.	200	2.00 9 hrs.	

I (e)

AMERICAN CITIES (Continued)

METHODS OF CLEANING USED

Sweeping		Flushing		Squeegeeing
Machine	Hand	Hose	Machine	
Sheet asphalt, rough block, brick, cobble, asphalt, block, bituminous.	Sheet asphalt, rough block, brick, concrete, bitulithic, asphaltic concrete, macadam, cobble, asphalt block and bituminous.	Asphalt, rough block, brick.	No.	No.
Brick, concrete, bitulithic.	Brick, concrete, bitulithic, macadam.	.....	Brick, concrete, bitulithic.	.....
Macadam and cobble.	Macadam and cobble.	.....	Sheet, rough block, brick, wood block, bitulithic, bituminous.	.....
Smooth pavements frequently.	Smooth pavements frequently.	.....	Smooth pavements occasionally during summer.	.....
None.	All.	None except sidewalks.	Sheet asphalt, brick, wood block, concrete, smooth block.	Sheet asphalt.
Yes.	Yes.	.....	Yes.	.....
Yes.	Yes.	.....	Yes.	.....
.....	Yes.	.....	Yes.	.....
.....	Yes.	.....	.....	.....
Brick, asphalt and concrete.	.....	.....	.....	.....
.....	.....	.....	.....	.....
.....	Asphalt and brick.	.....	Asphalt, rough block, brick and wood block.	.....
Yes.	Rough block.	.....	.....	.....
.....	.....	.....	Yes.	.....
.....	Brick and macadam.	.....	.....	.....
Brick, wood block, bitulithic, asphalt block, bituminous.	.....	.....	Yes.	.....
.....	All.	All.	All.	.....
.....	Yes.	.....	Yes.	.....
.....	All.	All hills.	All except hills.	.....
Yes.	Yes.	Yes.	Yes.	Yes.
Smooth block.	Sheet asphalt, brick, wood block, concrete, bitulithic, macadam, smooth block, bituminous.	.....	.....	.....
.....	All.	.....	.....	.....
Brick and macadam.	.....	.....	Brick and Macadam.	.....
.....	All.	.....	.....	.....
Sheet asphalt, brick, concrete, bitulithic, asphaltic concrete, macadam.	Same as machine.	None.	Sheet asphalt, rough block, wood block.	Sheet asphalt, bitulithic, asphaltic concrete.
.....	Yes.	.....	Yes.	.....
.....	Concrete, brick, bituminous.	.....	.....	.....
Sheet asphalt, rough block, brick, wood block, smooth block, cobble, asphalt block, bituminous, iron slag.	Same as machine.	Same as sweeping.	Same as sweeping except cobble.	Sheet asphalt, wood block, smooth block, asphalt block.
None.	Sheet asphalt, wood block, concrete, bitulithic.	Rough block, cobble.	Sheet asphalt, brick, wood block, concrete, bitulithic.	None.
Sheet asphalt.	Sheet asphalt, rough block, brick, wood block.	.....	Same as hand sweeping.	.....
.....	All.	.....	Will start soon.	.....
Yes.	No.	Yes.	No.	No.
.....	All.	.....	.....	.....
Yes.	Yes.	.....	Yes.	.....
.....	Yes.	Yes.	Yes.	.....
Sheet asphalt, brick, wood block, asphaltic concrete, smooth block.	Sheet asphalt, macadam, smooth block, bituminous.	.....	Sheet asphalt occasionally.	.....
Sheet asphalt, rough block, brick, wood block.	Sheet asphalt, wood block, macadam, bituminous.	.....	Sheet asphalt, rough block, brick.	.....
Yes.	Yes.	Yes.	Yes.	No.
Sheet asphalt, rough block, brick, smooth block, cobble, asphaltic block, miscellaneous.	Bitulithic, asphaltic concrete, macadam, bituminous.	Concrete.	Rough block, brick, smooth block.	Sheet asphalt, wood block.
Rough block.	Sheet asphalt, brick, wood block, bitulithic, macadam, smooth block, bituminous.	.....	.....	.....

Table I (e)

STREET CLEANING IN

City	Force								
	Number of Foremen and Inspectors	Wages and Hours Daily*	Number of Mechanics and Skilled Laborers	Wages and Hours Daily*	Number of Teams	Cost and Hours Daily*	Number of Unskilled Employees	Wages and Hours Daily	All Others Employed
Rochester	20–25	2.00	.....	.....	15–18	4.80	400	1.75–2.00	.....
Rensselaer	2	.....	3	2.00	7	.....	.....	.....	.....
Reading	.....	.....	.....	.....	.....	.....	.....	.....	.....
Richmond	6	2.62½ 9 hrs.	3	2.75 9 hrs.	.....	.....	180	2.25 9 hrs.	3
St. Louis	50	75.00 Mo.	.....	.....	177	4.00	675	1.50	12
San Francisco	22	3.50	3	3.75	67	6.50	168	3.00	12
Salt Lake City	4	3.20	1	4.00	20	4.50	24	2.25	70
Springfield	1	4.00	.....	.....	16	5.60	105	2.40	.....
Seattle	30	90.00–115.00 Mo.	.....	3.00	City teams	.....	.....	3.00	.....
Scranton	.....	.....	.....	.....	.....	.....	.....	.....	.....
Troy	2	2.00	3	3.00	8	3.46	2	2.00	.....
Utica	7	.....	180	.....	27	.....	.....	.....	.....
Washington	19	720–1,300	.....	.....	70	.....	406	1.50–2.50	11

(Continued)

AMERICAN CITIES (Continued)

Methods of Cleaning Used				
Sweeping		Flushing		Squeegeeing
Machine	Hand	Hose	Machine	
Rough block, brick, cobble.	Sheet asphalt, rough block, brick, wood block, bitulithic, macadam, cobble, bituminous.	Sheet asphalt, rough block, brick, bitulithic, bituminous.	Same as hose.	None.
Yes.	.....	.....	.....	.....
.....	.....	.....	Yes.	.....
.....	.....	.....	.....	.....
.....	.....	.....	.....	.....
Yes.	Yes.	.....	Yes.	Yes.
Yes.	.....	.....	Yes.	.....
Yes.	Yes.	.....	.....	Yes.
Plank roads.	.....	.....	All except plank roads.	No.
Yes.	Yes.	.....	Yes.	.....
Rough block, brick, macadam.	.....	.....	Sheet asphalt, bitulithic, smooth block.	.....
Yes.	Yes.	.....	Yes.	.....
All except dirt.	All.	None.	Rough, smooth and asphalt block, brick, cobble.	Sheet asphalt, brick, asphaltic concrete, smooth and asphalt block.

Table

STREET CLEANING IN

City	Number of Appliances Used	Which Are Giving Satisfaction	Total Square Yards Cleaned	Times Cleaned per Week	
				Winter	Summer
Buffalo	37 horse sweepers, 10 horse sprinklers	All.	.....	.....	.....
Beacon	.....	.....	.....	.....	.....
Binghamton	1 horse drawn flusher, 4 horse drawn rotary brooms.	.....	.....	.....	6
Cincinnati	6 horse scrapers, 40 horse flushers.	.....	.....	.....	.....
Cambridge	8 horse sweepers, 1 horse squeegee, 4 horse sprinklers, 2 horse oilers.	.....	.....	.....	.....
Chicago	1 horse sweeper, 2 horse squeegees, 75 horse flushers, 3 power flushers, 35 horse oilers.	All satisfactory.	.....	.....	.....
Camden	.....	.....	.....	.....	.....
Columbus	8 flushers, 16 sprinklers, 11 horse sweepers, railway flusher.	.....	.....	.....	.....
Cleveland	Street car flusher in addition to other equipment.	.....	.....	.....	.....
Cortland	2 horse sprinklers, 1 horse oiler.	.....	.....	.....	.....
Dunkirk	Motor and horse sweepers.	.....	.....	.....	6
Denver	12 horse sweepers, 3 horse sprinklers, 8 horse flushers, 8 pick-up sweepers.	.....	.....	.....	.....
Elmira	1 horse sprinkler, 1 horse flusher, 3 horse sweepers held in reserve.	.....	Sheet asphalt 104,649, rough block 28,101, brick 295, 159, wood block 1,530.	.....	1–6
Fall River	4 horse sweepers, 1 horse sprinkler, 4 horse road oilers.	.....	.....	.....	.....
Grand Rapids	2 horse flushers, 31 horse sprinklers.	.....	.....	.....	.....
Hudson	.....	.....	.....	.....	Brick once, macadam, 4 times a year.
Jamestown	2 power sweepers, 1 horse flusher.	All except horse flusher.	.....	.....	.....
Kansas City	4 machine sweepers, 31 horse flushers.	.....	Sheet asphalt, 4,913,158, rough block 145,204, brick 859,982, wood block 161,-545, concrete 1,246,367, bitulithic 14,639, macadam 1,074,579, Imperial 11,288,	.....	.....
Kingston	1 horse flusher, 2 horse oilers.	.....	Brick 730,666.	.....	.....
Los Angeles	31 horse and 5 power flushers, 40 to 100 horse sprinklers.	.....	.....	.....	.....
Louisville	16 flushers, 2 squeegees.	.....	.....	.....	.....
Lowell	2 horse sweepers, 6 horse sprinklers, 2 power sprinklers, one power road oiler.	.....	.....	.....	.....
Lynn	2 horse sweepers, 2 horse sprinklers, 1 pick-up sweeper, 1 power road oiler.	.....	.....	.....	.....
Lackawanna	1 horse sweeper, 3 horse sprinklers, 1 horse flusher, one horse oiler.	.....	Brick 5.5 mi. Macadam 14 mi.	.....	2
Little Falls	.....	.....	.....	.....	.....
Milwaukee	8 horse sweepers, 10 horse squeegees, 2 power squeegees, 120 horse sprinklers, 16 horse flushers, 10 horse oilers, 2 pick-up sweepers.	All satisfactory.	Asphalt 1,600,170, brick 674,008, macadam 4,742,-044, granite 236,555, creosote 73,953, cedar 27,522, Mulleni mix 418,756, limestone 34,517, sandstone 168,321.	.....	.....
Middletown	2 horse sprinklers, one horse flusher, 1 road oiler, 1 pick-up sweeper.	Flushers.	Brick 88,235.	.....	.....
Mechanicville	.....	.....	.....	.....	.....
New York City	148 horse sweepers, 28 horse squeegees, 121 horse sprinklers, 4 horse flushers.	.....	28,420,785	19	19
New Orleans	18 horse sprinklers, 32 horse flushers.	Flushers.	Flushers cover 42,000 Sq. Yds. daily or all paved streets of smooth surface.	.....	.....

I (f)

AMERICAN CITIES (Continued)

Area Cleaned by White Wings During 8 Hours	Work in Gangs or Singly	Where and in What are Cleanings Stored by White Wings	Equipment of White Wings	How are Assignments of White Wings Determined?	Standard Day's Work for Cleaning Each Class of Pavement*
8,000 Sq. Yds.	Singly.	Barrels or tubs.	Broom, shovel, scraper cart.	.....	Heavy traffic 5,000 Sq. Yds., Light traffic 12,000 Sq. Yds., rough pavement 6,000 Sq. Yds., good pavement 12,000 Sq. Yds.
.....	.....	.....	.....	.....	.....
9,275 Sq. Yds.	Singly.	Bags.	Cart, broom, scraper, shovel, 3 bags.	.....	.....
8,661 Sq. Yds.	Singly.	Cans.	Cart, long and short handled broom, scraper.	Traffic, condition and kind of street.	Flushing, 35,550 Sq. Yds. gutters after flushing 6,000 to 8,000 lineal ft., brooming 5,330 to 7,100 Sq. Yds.
.....	Singly.	Gutters.	Can, shovel, cart and broom.	As needed.	None.
17,000 Sq. Yds.	Singly.	Metal boxes 4 Cu. Ft.	Broom, shovel, scraper cart.	.....	Asphalt 21,500 Sq. Yds., Brick 13,400 Sq. Yds., Granite 13,400 Sq. Yds., Macadam 21,500 Sq. Yds.
.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....
.....	Singly.	Gutter.	Scraper and broom.	By traffic.	Each man has definite area to clean.
.....	.....	.....	.....	.....	.....
.....	Singly.	Alley boxes.	Cart, shovel, broom scraper.	Teams travel 3 miles an hour, routes cover 22 to 23 miles, allowing for filling and oiling.	None.
.....	Both.	Cans.	Broom, shovel and hand cart.	By traffic.	None.
.....	Singly.	Cans.	Broom and cart.	By street superintendent.	None.
.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....
.....	Singly.	Bags in alleys.	.....	.....	.....
10 to 15 blocks.	Gangs.	Gutters.	Cart, broom, shovel.	By district superintendent.	None.
.....	Singly.	Cans.	Can carrier and push broom.	.....	.....
.....	Singly.	Gutters and side streets.	Brooms and scrapers.	Area, amount in nature of traffic and street.	Controlled by local conditions.
No White Wings.	Gangs.	.....	.....	.....	.....
6,000 Sq. Yds.	Singly.	Gutters.	Push and hand brooms and hand pan.	.....	.....
.....	Singly.	Gutters.	Broom, cart, shovel.	By foremen.	.....
.....	Gang.	Gutter.	Push brooms.	.....	Yes.
.....	Singly.	Cans at Corners.	Broom, cart with dust-pan.	By condition of pavement and traffic.	Each man has definite area to clean.
5,000 to 25,000	Singly.	Receptacles.	Pan scraper and broom.	According to traffic.	.....
.....	Gangs.	.....	Broom, shovel.	.....	.....
.....	Singly.	Vacant lots.	Cart, broom and shovel	.....	Each man has definite area to cover.
9,000 Sq. Yds.	Both.	Cans.	Can carrier, 5 cans, scraper, broom, shovel.	Population, traffic, character of buildings and pavements.	.....
.....	Gangs.	Gutters.	Shovel and hand brooms.	By foremen	None.

Table I (f)

STREET CLEANING IN

City	Number of Appliances Used	Which Are Giving Satisfaction	Total Square Yards Cleaned	Times Cleaned per Week	
				Winter	Summer
New Bedford..	4 horse sweepers, 1 pick-up sweeper.	All except pick-up sweeper.	Sheet asphalt and bitulithic 141,098.22, rough block 98,843.03.	.....	.....
Newark.....	27 horse sweepers, 8 horse flushers.	.....	.....	.....	.....
Norwich.....	1 horse sweeper, 4 horse sprinklers.	Sweeper not satisfactory.	Brick 50,000, bitulithic 15,000, bituminous 35,000.	.....	1–2
New Rochelle..	1 horse sprinkler, 2 horse oilers.	.....	1,290,632	.....	6
Niagara Falls..	4 horse sweepers, 1 horse sprinkler, 2 horse flushers.	.....	900,000	.....	.....
Newburgh.....	1 horse sweeper rarely used, 1 power flusher, 1 horse oiler.	.....	.....	.....	.....
Oakland.....	2 rotary power sweepers, 2 horse flushers, 1 power suction sweeper.	Suction sweeper doing excellent work but too expensive.	Sheet asphalt 344,116, brick 4,200, wood block 12,000, asphaltic concrete 4,800, macadam 3,733,000, smooth block 4,500, bituminous 3,600,000.	Same as summer.	Sheet asphalt, 2–6, brick 3, wood block 6, asphaltic concrete 2–6, smooth block 3–6, macadam and bituminous 1 to 4 times a year.
Oswego.....	1 horse flusher, 1 pick-up sweeper.	.....	Sheet asphalt 53,059, rough block 6,578, brick 111,638, wood block 3,555.	.....	Sheet asphalt 2–4, rough block and brick the same, wood block 6.
Ogdensburg....	1 horse sweeper, one horse flusher, 1 horse sprinkler.	.....	.....	.....	.....
Philadelphia...	77 horse sweepers, 28 horse squeegees, 51 horse sprinklers all year and 28 extra in summer. 7 power flushers.	All satisfactory.	Sheet asphalt 7,722,806, rough block 62,380, brick 2,615,102, wood block 218,-037, concrete 750,139, macadam, bitulithic and asphaltic concrete 2,850,-404, smooth block, 6,534,-737, cobble 57,752, asphalt block 69,950, bituminous 984,813, slag block 54,242.	.....	Sheet asphalt, rough block, brick, smooth and asphalt block 2–6, wood and slag block and cobble 3–6, concrete 1–6, macadam and bituminous 1.
Providence....	3 horse sweepers, one horse sprinkler, 2 horse oilers, 1 power oiler.	.....	Sheet asphalt 168,604.6, brick 6,734.8, wood block 72,576.5, bitulithic 172,-901.9, macadam 3,243,386, granite block 691,342.9, cobble 47,669.2, bituminous 101,764.	.....	.....
Rochester.....	9 horse sweepers, 40 horse sprinklers, 4 horse flushers.	.....	.....	.....	.....
Rensselaer.....	2 horse sweepers, 1 horse sprinkler.	.....	.....	.....	.....
Reading.....	.....	.....	.....	.....	.....
Richmond.....	6 rotary machine sweepers, 1 power rotary machine sweeper, 3 horse sprinklers, 3 horse flushers, 1 pick-up sweeper.	.....	.....	.....	.....
St. Louis.....	11 horse sweepers, 4 horse squeegee machines, 10 horse sprinklers, 4 horse road oilers, 2 power road oilers.	.....	Rough block 1,615,428, brick 4,390,336, wood block 383,590, bitulithic 1,170,-528, asphalt block 1,867,-340.	.....	.....
San Francisco..	9 horse sweepers, 3 horse squeegees, 3 horse sprinklers, 15 combination sprinklers and flushers, 1 auto flusher, 3 20th century sweepers.	.....	.....	.....	.....
Salt Lake City.	15 horse flushers.	.....	.....	.....	.....
Springfield.....	6 horse sweepers, 2 horse squeegees, 14 horse sprinklers, 2 power oilers, 1 horse and 1 hand pick-up sweeper.	.....	.....	.....	.....
Seattle.....	.....	All except squeegee.	.....	.....	.....
Scranton.....	Street car flusher owned by company, city furnishes 2 men to operate it—auto flusher.	.....	.....	.....	.....
Troy.....	6 horse sweepers, 2 horse sprinklers, 2 power flushers.	.....	Sheet asphalt 119,347, rough block 399,143, brick 327,969, bitulithic 12,389, macadam 53,543, smooth block 58,641.	.....	Asphalt 6, rough block, brick and macadam 2, bitulithic and smooth block 6.
Utica.....	9 horse sweepers, 3 horse sprinklers, 2 power sprinklers, 1 horse flusher, 2 power flushers.	.....	.....	.....	.....
Washington....	9 horse sweepers, 13 horse squeegees, 12 horse sprinklers, 3 horse flushers, 5 horse oilers, 7 alley sweepers, 3 alley sprinklers.	.....	.....	.....	.....

(Continued)

AMERICAN CITIES (Continued)

Area Cleaned by White Wings During 8 Hours	Work in Gangs or Singly	Where and in What are Cleanings Stored by White Wings	Equipment of White Wings	How are Assignments of White Wings Determined?	Standard Day's Work for Cleaning Each Class of Pavement
.....	Singly.	Gutters.	Cart and broom.	.....	None.
.....	Gangs.	Gutters.	Broom, hoe and scoop.	.....	None.
.....	.....	.....	.....	.....	.....
.....	Singly.	Cans.	Can, cart, broom and scraper.	.....	None.
8,000 Sq. Yds.	Singly.	Cans.	Scraper, cart, broom.	.....	Each man has definite area to clean.
.....	Singly.	Gutters.	Wheelbarrow, broom, shovel.	Age of sweeper and traffic.	None.
.....	Singly.	Cans at curb.	Hand scoop and broom with scraper.	Area and traffic.	8,000 Sq. Yds. upward according to horse traffic.
.....	Gangs.	Cans and gutters.	Scraper and broom.	.....	Each man has definite area to cover.
3,000 Sq. Yds.	Singly.	Barrels in alleys.	Cart, shovel and broom.	.....	Each man has definite area to clean.
4,000 in business, 18,000 in outlying.	Gangs on macadam, singly on others.	Cans and bags.	Bag carrier, bags, broom, watering pan, scraper, plug wrench.	Number of cleanings, traffic and population density.	Machine broom 90,000 Sq. Yds., auto flusher 90,000, squeegee 80,000.
3,500 to 16,000 Sq. Yds. 9 hrs.	Singly.	Gutters and cans at curb.	Pan, broom, shovel, cart.	Fitness for condition of area.	Yes.
.....	Both.	Barrel.	Cart, broom, scraper, barrel.	.....	.....
.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....
.....	.....	In alleys.	Push cart and broom.	.....	.....
2,400–4,800	Singly.	.....	Push cart or roller scraper, hoe, broom, shovel.	.....	.....
9,000 Sq. Yds.	Blockmen singly.	Cans at curb have holes in top for depositing papers.	Broom with sweeper, pick-up can, cleaners with pan attached.	By superintendent.	.....
1½ blocks.	.....	Cans.	Push cart and broom.	By foreman.	.....
.....	Singly.	Cans.	Broom, scraper, cart, cans.	By foreman.	.....
.....	Singly.	Cans.	Broom, scraper and two wheeled cart.	Traffic conditions.	.....
.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....
¼ Sq. Mi.	Singly.	Cans.	Scraper, push and hand broom, can and shovel.	.....	.....
.....	Singly and in pairs.	Sacks in alley.	Bag carrier, shovel, pan scraper, combination broom.	By foreman and office planning.	No.

Table

STREET CLEANING IN

City	How is Efficiency of Employees Checked Up?	System and Method of Street Cleaning	Organization of Street Cleaning Force
Buffalo	Supervisor.	Residential, hand and machine sweeping; business, flushing and White Wings.	.....
Beacon	.....	.....	.....
Binghamton	.....	Swept at night.	.....
Cincinnati	Foreman's field reports.	Residential, flushing followed by guttermen; business, flushing followed by White Wings. Flushing at night except in winter. Streets not flushed are broomed by gangs.	Foremen, drivers, helpers, broom-men and White Wings.
Cambridge	None.	Residential, swept twice year; business, once a week.	.....
Chicago	Supervision by ward superintendent and section foreman.	Residential, block system; each man has section to clean. Business the same.	.....
Camden	.....	.....	.....
Columbus	.....	.....	.....
Cleveland	.....	.....	.....
Cortland	Complaints of residents.	.....	.....
Dunkirk	.....	.....	.....
Denver	Supervision	Residential, sweepers; business, White Wings and flushers.	.....
Elmira	.....	Residential, day flushing and gang picking; business, night flushing and day patrol	.....
Fall River	None.	Daily patrol in business section; scrap gutters in residential twice a year.	.....
Grand Rapids	.....	.....	.....
Hudson	.....	.....	.....
Jamestown	.....	.....	.....
Kansas City	Monthly, grades by commissioner to civil service.	Residence, winter, hand sweeping; summer, flushing. Business, flush at night.	In gangs under foreman and district superintendent.
Kingston	.....	.....	.....
Los Angeles	Thorough supervision.	Patrol system.	Five foremen in 5 districts.
Louisville	.....	.....	.....
Lowell	.....	Residential, patrol; business, patrol and machine sweeping.	Foreman, 8 men, two teams in residential. Foreman, 8 men, 2 teams, machine sweeper and sprinkler.
Lynn	By foreman.	.....	.....
Leckawanna	Foreman.	Sweeper, sprinkler, push brooms.	One gang for each ward.
Little Falls	.....	.....	7 sweepers with one street superintendent.
Milwaukee	.....	.....	.....
Middletown	.....	A section assigned to sweeper; flushed after hand sweeping.	.....
Mechanicville	None.	Hand sweeping.	One man on given beat.
New York City	Officers.	Hand and machine sweeping, hose and machine flushing, squeegeeing, litter picking.	District superintendent, section foreman, assistant section foreman, sweepers, drivers.
New Orleans	.....	Smooth surfaces flushed daily. Hand broom men follow flushers. Business section cleaned at night by flushers and hand cleaning.	.....
New Bedford	.....	.....	.....
Newark	.....	Ten districts. Number of men assigned to each according to size of district.	.....
Norwich	None.	Sweep to gutters, shovel into piles and then into wagons.	Sweeper team, wagon team.
New Rochelle	Supervision of Commissioner and time keeper.	By hand broom.	.....
Niagara Falls	By 2 deputy superintendents.	Residential, sweeping; business, flushing.	.....
Newburgh	.....	.....	.....

I (g)

AMERICAN CITIES (Continued)

Innovations that Have Reduced Cost of Cleaning	How Are Machines Routed?	Gallons Water Used per 1,000 Sq. Yds Cleaned		City Own Horses and Wagons?	Street Sprinkling		
		Flushing Machine	Squeegee		Sprinkle Streets for Laying Dust Only?	Sq. Yds. Sprinkled During Year	Driver's Daily Wage*
.....	By districts.	.....	.....	Yes.	Yes.	18,000,000	.....
.....	.....	.....	.....	.....	.....	.....	.....
Will clean between 11 P.M. and 7 A.M. when traffic is light and few autos are parked.	Usually in batteries of three.	500.	.....	No horses.	By private contract.	.....	.....
.....	3 men to each route.	844.	.....	Yes.	Private contract.	.....	.....
No.	.....	.....	.....	Yes.	Yes.	.....	.....
.....	.....	400.	65.	No.	No.	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	Yes.	86,133.	4.00.
Sweep streets before flushing.	According to nature of dirt.	.....	.....	No.	Yes.	.....	2.25.
.....	.....	400.	.....	No.	.....	.....	.....
.....	.....	.....	.....	.....	Some.	.....	2.65.
.....	.....	.....	.....	.....	Yes.	236 miles.	.....
.....	.....	.....	.....	.....	Yes.	358,000.	2.10.
.....	Two routes, north and south side of city.	.....	.....	Yes.	.....	.....	.....
No.	Districts.	5,000,000 all flushing squeegee	daily for ng except ing.	Yes, some hired.	By contract No.	.....	.....
.....	.....	.....	.....	Yes.	.....	.....	.....
Routed all men or assigned to each route to increase area from business center out.	.....	4,900.	.....	Wagons.	Yes.	447 miles, 40' width.	.....
.....	.....	.....	.....	Yes.	.....	.....	.....
.....	.....	.....	.....	Yes.	Yes.	.....	2.50.
No.	.....	.....	.....	Yes.	Yes.	.....	3.04.
.....	.....	.....	.....	No.	Yes.	313,550.	.....
.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	Yes.	Yes.	.....	.....
.....	.....	.....	.....	Wagons.	Yes.	.....	.....
Motorised a section known as model district; systematised machine sweeping, squeegeeing and hose flushing covered parts.	Area and traffic conditions.	.....	.....	Yes.	Contractor.	.....	.....
.....	.....	.....	.....	.....	.....	.....	2.00.
.....	.....	.....	.....	Yes.	Yes.	.....	2.80.
Men held responsible for these districts.	.....	.....	.....	.....	No.	.....	.....
.....	.....	.....	.....	Wagons.	Yes.	.....	1.60.
.....	.....	.....	.....	Yes.	Yes.	.....	2.25.
.....	.....	.....	.....	Wagons.	Some.	.....	.....
.....	.....	.....	.....	Yes.	.....	.....	.....

Table I (g)

STREET CLEANING IN

City	How is Efficiency of Employees Checked Up?	System and Method of Street Cleaning	Organization of Street Cleaning Force
Oakland	Patrolmen visited once or twice daily by foreman; contract work inspected daily.	Small gangs on macadam, occasional flushing after wet weather. Machine sweeping and patrol.	Gangs of 6 to 8 men under sub-foreman. Directed by district superintendent of streets on macadam. Patrol and machine sweeping.
Oswego	.....	Pick-up sweeper, flushing and hand sweeping.	.....
Ogdensburg	By foremen.	Residential sprinkled and machine swept; business patrolled and flushed.	.....
Philadelphia	Inspectors supervised by district engineers.	Blockmen assigned to sections by chief of bureau; patrol duty. Inlets cleaned, county roads cleaned.	Machines followed by gangs and carts and wagons, number depending on length of haul to dump, season of the year and traffic.
Providence	Foreman's daily report of neglect of duty.	Residential, gangs; business, patrol.	Residential, foreman, 17 men and 10 single teams; business, patrol in charge of foreman.
Rochester	.....	Residential, gang and patrol; business, patrol.	.....
Rensselaer	.....	.....	.....
Reading	.....	.....	.....
Richmond	.....	.....	.....
St. Louis	.....	.....	.....
San Francisco	Time cards, trip cards, efficiency cards as to attendance, sobriety and obedience.	.....	Residential, gangs of foremen, 3 laborers and 2 teams each. Business, blockmen, night gangs of 2 foremen, 9 laborers and 8 double teams.
Salt Lake City	.....	White Wings and flushing.	.....
Springfield	Foreman calls on each man several times daily.	Residential, crosswalk sweepers, machine cleaning, gutter scraping. Business, squeegeeing, flushing, patrol.	Individuals and gangs.
Seattle	Reports from foremen and district foremen.	Residential, flushing, sweeping and patrol; business, flushing and patrol.	Residential, under sub-foreman; business, under district foreman.
Scranton	.....	Business, hand and machine sweeping and flushing. Residential hand and machine sweeping.	.....
Troy	.....	Smooth streets flushed, rough streets and brick, machine swept. Patrol.	.....
Utica	.....	.....	.....
Washington	Unit cost, conditions, observation.	Residential, machine and hand cleaning, squeegeeing, flushing, oiling and sprinkling. Business, patrol, squeegeed or flushed.	Assistant superintendent, chief inspector, foremen, working force.

(Continued)

AMERICAN CITIES (Continued)

Innovations that Have Reduced Cost of Cleaning	How Are Machines Routed?	Gallons Water Used per 1,000 Sq. Yds. Cleaned		City Own Horses and Wagons?	Street Sprinkling		
		Flushing Machine	Squeegee		Sprinkle Streets for Laying Dust Only?	Sq. Yds. Sprinkled During Year	Driver's Daily Wage
Readjusted patrol routes; substituted hand patrol for suction sweeper.	Swept 2, 3, 4 and 6 times weekly. 2 and 3 times schedules adjacent to 4 and 6 times schedules.	.....	.....	Yes.	Macadam streets.	.....	$2.25 to $3.00
.....	By yardage.	.....	.....	No.	No.	.....	.....
Flushing.	.....	.....	.....	No.	Some.	.....	1.75.
Street cleaning parade annually.	Batteries of 2 or 3.	300.	250.	No.	Yes.	.....	.....
.....	Divide into 6 sections.	.....	.....	Yes.	No.	.....	.....
.....	.....	.....	.....	No.	Yes.	.....	.....
.....	.....	.....	.....	No.	Yes.	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....
Elgin machine sweeping in residential section.	.....	.....	.....	Yes.	No.	.....	.....
By scrubbing business districts streets nightly cost reduced 40c. per great square.	.....	.....	.....	Yes, flushers hired.	Yes, by contract.	14,000,000.	.....
.....	.....	.....	.....	No.	Yes.	382,344,363	.....
.....	.....	.....	.....	Wagons and some horses	Yes.	150 miles.	.....
.....	.....	.....	.....	Some.	.....	.....	30c. hour.
Flushing is most economical.	.....	.....	.....	Yes.	No.	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....
.....	By districts.	.....	.....	No.	No.	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....
.....	By foremen, subject to superintendent's approval	1,500.	162.	Yes.	Some macadam and unpaved streets.	.....	2.25. 1.75.

Table

STREET CLEANING IN

City	Street Sprinkling			
	Daily Cost per Team*	Total Annual Cost of Street Sprinkling	Paid out of City's General Fund?	Paid by Abutting Property Owners?
Buffalo	.....	$10,000.00	.....	Yes.
Beacon	.....	.....	.....	.....
Binghamton	.....	.....	.....	.....
Cincinnati	.....	.....	.....	.....
Cambridge	.....	40,000.00T	No.	Yes.
Chicago	.....	.....	.....	.....
Camden	.....	.....	.....	.....
Columbus	.....	.....	.....	.....
Cleveland	.....	.....	.....	.....
Cortland	.....	948.68	.....	Yes.
Dunkirk	.....	.....	.....	.....
Denver	$2.50	80,227.95	Yes.	.....
Elmira	.....	.....	.....	.....
Fall River	6.00	2,809.24	No.	Yes.
Grand Rapids	.....	25,131.23	.....	.....
Hudson	.....	1,500.00	Yes.	.....
Jamestown	.....	.....	.....	.....
Kansas City	.....	.....	.....	.....
Kingston	.....	.....	.....	.....
Los Angeles	4.45	.....	.....	No.
Louisville	.....	.....	.....	.....
Lowell	6.00	.....	$17,000	Yes.
Lynn	.....	24,061.77	.....	Yes.
Lackawanna	4.75	.....	.....	Yes.
Little Falls	.....	.....	.....	.....
Milwaukee	.....	60,310.05	5,205.28DD	Most.
Middletown	.....	.....	No.	Yes.
Mechanicsville	5.00	1,200.00	Yes.	.....
New York City	.....	.....	.....	.....
New Orleans	.....	.....	.....	.....
New Bedford	.....	3,061.59	Yes.	.....
Newark	.....	.....	.....	.....
Norwich	5.00	1,700.00	No.	50%
New Rochelle	.....	1,202.32	Yes.	.....
Niagara Falls	5.00	2,000.00	Yes.	.....
Newburgh	.....	.....	.....	.....
Oakland	5.00–6.00	43,651.95	Yes.	.....
Oswego	.....	.....	.....	.....
Ogdensburg	4.00	.....	.....	Yes.
Philadelphia	.....	24,367.14	Yes.	.....
Providence	.....	.....	.....	.....
Rochester	.....	42,271.73	.....	Yes.
Rensselaer	.....	.....	.....	.....
Reading	.....	.....	.....	.....
Richmond	.....	.....	.....	.....
St. Louis	.....	250,000.00	.....	Yes.
San Francisco	.....	.....	Yes.	No.
Salt Lake City	4.50	25,000.00	Yes.	.....
Springfield	.....	13,493.68	Yes.	.....
Seattle	.....	.....	.....	.....
Scranton	.....	.....	.....	.....
Troy	.....	.....	.....	.....
Utica	.....	.....	.....	.....
Washington	3.55	4,633.58	Yes.	.....

I (h)

AMERICAN CITIES (Continued)

Street Sprinkling				
Method of Assessment. Who Pays for Street Intersections?	Total Gallons Used a Year for Sprinkling	Average Rate of Assessment per Foot Front for Sprinkling	Does This Include Cost of Water or is Water Non-assessable?	Do Corporations Sprinkle Streets on Which the Trolley Cars Run?
No charge for intersections.	7,500,000	10c	Yes.	On two streets.
.....	.....	.....	.....	.....
.....	.....	.....	.....	.....
4c. front foot each side; intersections not counted.	15,000,000	4c.	No.	No.
.....	.....	.....	.....	.....
.....	.....	.....	.....	.....
.....	.....	.....	.....	.....
City pays for intersections.	6,470	5c.	Yes.	No.
.....	.....	.....	.....	.....
.....	311,364,000	.....	City pays $25 a year for hydrant for all purposes.	No.
.....	.....	.....	.....	No.
Intersections paid by city.	4,403,200	2c.	Non-assessable.	No.
.....	117,821,750	.....	.....	Yes.
.....	.....	.....	.....	.....
.....	.....	.....	.....	.....
.....	.....	.....	.....	.....
.....	.....	.....	.....	.....
.....	40,000 tanks per month, each tank 550 gallons.	.....	.....	No.
.....	.....	.....	.....	.....
City pays for intersections. V	.....	5.5c.	Yes.	No.
No pay for intersections. 5c. per foot front in residential; 8c. in business.	.....	.....	No cost.	No.
.....	.....	.....	Non-assessable.	No.
.....	.....	.....	.....	.....
Assessed to property owners.	.....	1.6c. CC	Non-assessable.	.....
City pays for intersections ½c. per front foot per week.	.....	.....	Non-assessable.	No.
.....	8,000,000	.....	.....	No.
.....	.....	.....	.....	.....
.....	.....	.....	.....	.....
.....	.....	.....	.....	EE
.....	.....	.....	.....	.....
.....	.....	3c.	Yes.	No.
.....	1,100,509	.....	.....	Yes.
.....	.....	.....	.....	Yes.
.....	.....	.....	.....	.....
.....	10,197,400 Cu. Ft.	.....	.....	Few cases.
.....	.....	.....	.....	No.
.....	.....	.....	.....	No.
.....	.....	.....	.....	No.
.....	.....	.....	.....	.....
.....	.....	.....	.....	Pays proportionate cost.
.....	.....	.....	.....	.....
.....	.....	.....	.....	.....
Special tax 4c. per foot front.	1,727,362,500	4c.	Non-assessable.	.....
.....	.....	.....	.....	At times.
.....	.....	.....	.....	.....
.....	.....	.....	Yes.	Yes, $100 a mile.
.....	.....	.....	.....	Yes. FF
.....	.....	.....	.....	.....
.....	.....	.....	.....	No.
.....	.....	.....	.....	.....
.....	.....	.....	.....	.....

Table

STREET CLEANING IN

City	Cost Data				
	Street Cleaning Done by City or Contract	Yearly Contract Price	Total Cost of Street Cleaning Year, Exclusive of Snow Removal	Salaries and Wages	New Appliances
Buffalo	City.	.....	$146,517.43	$84,499.70	$17,233.42
Beacon	City.	.....	.....	.....	.....
Binghamton	City.	.....	.....	.....	.....
Cincinnati	City.	.....	186,847.17	.....	.....
Cambridge	City.	.....	59,300.00	47,500.00	500.00
Chicago	City.	.....	.....	.....	.....
Camden	City.	.....	26,056.80	.....	.....
Columbus	City.	.....	126,897.19	94,180.68	.....
Cleveland	.....	.....	.....	.....	.....
Cortland	City.	.....	31,000.00	.....	.....
Dunkirk	Contract.	2.8c. per Sq. Yd. per season.	.....	.....	.....
Denver	City.	.....	108,296.60	.....	.....
Elmira	City.	.....	11,748.20	10,047.18	1,000.00
Fall River	City.	.....	53,867.80	.....	.....
Grand Rapids	City.	.....	.....	.....	.....
Hudson	City.	.....	1,400.00	.....	.....
Jamestown	City.	.....	5,638.70	3,983.67	.....
Kansas City	City.	.....	200,000.00	170,000.00	.....
Kingston	City.	.....	9,500.00	9,300.00	100.00
Los Angeles	City.	.....	.....	.....	.....
Louisville	City.	.....	80,819.80	.....	.....
Lowell	City.	.....	.....	.....	.....
Lynn	City.	.....	29,298.85	.....	.....
Lackawanna	City.	.....	.....	.....	.....
Little Falls	City.	.....	.....	.....	.....
Milwaukee	City.	.....	238,335.00 including sprinkling.	.....	.....
Middletown	City.	.....	3,975.65	.....	.....
New York City	City.	.....	7,643,936.74	5,380,620.63	.....
New Orleans	City.	.....	322,000.00	.....	.....
New Bedford	City.	.....	60,478.81	.....	.....
Newark	City.	.....	268,732.54	237,213.15	.....
Norwich	City.	.....	.....	.....	.....
New Rochelle	City.	.....	37,665.71	34,974.67	.....
Niagara Falls	City.	.....	118,000.00	.....	.....
Newburgh	City.	.....	9,000.00	.....	.....
Oakland	Both.	$44,663.44	74,951.32	25,969.258	.....
Oswego	City.	.....	4,231.41	3,226.01	517.79
Ogdensburg	City.	.....	4,428.66	.....	.....
Philadelphia	Contract.	1,232,847.00	.....	.....	.....
Providence	City.	.....	.....	.....	.....
Rochester	City.	.....	183,783.44	.....	.....
Rensselaer	City.	.....	2,740.00	.....	.....
Reading	Contract.	Three year basis $12.90 per city square, length 540 ft. $35,000 a year.	.....	.....	.....
Richmond	City.	.....	Not separated from garbage and ash collection.	.....	.....
St. Louis	City.	.....	527,000.00	.....	.....
San Francisco	City.	.....	350,400.00	.....	6,000.00
Salt Lake City	City.	.....	.....	.....	.....
Springfield	City.	.....	243,952.86	.....	.....
Seattle	City.	.....	148,456.56	.....	.....
Scranton	.....	.....	.....	.....	.....
Troy	City.	.....	.....	.....	.....
Utica	City.	.....	.....	.....	.....
Washington	City.	.....	264,869.70	.....	.....

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AMERICAN CITIES (Continued)

Cost Data					
Repairs and Maintenance of Appliances	Other Expenses	Cost per 1,000 Sq. Yds. Street Cleaning Done	Average Cost per Sq. Yd. of Hand Sweeping	Average Cost per Sq. Yd. of Machine Flushing #	Average Cost per Sq. Yd. of Squeegeeing #
$44,784.41	.....	28c.	30c.	.....	.....
.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....
.....	.....	.00035	.....	.....	.....
300.00	$11,000.00	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....
238.09	.....	.....	.....	.....	.....
.....	.....	.....	.388c.	.617 per Gr. Sq. GG	.....
.....	.....	.....	.42786 per Gr.Sq.	.15388 per Gr.Sq. GG	.....
.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....
.....	.....	One-sixth of a mill.	15-100 of a mill	13-100 of a mill	.....
711.52	.....	0.397	0.321	0.0815	.....
.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.0385 P.HH	.....
.....	.....	.....	.....	.....	.....
1,655.03	.....	.1464c.	.....	.....	.....
80,000.00	.....	.....	.....	.....	.....
50.00	50.00	.....	.....	.....	.....
.....	.....	.....	.069 to .285 per day.P	.16 to .21P	.....
.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	26.2c.-35.3c.P	25.5c. P
.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....
2,245.79	445.25	26c.	.027c.	.....	.....
20,000.00	10,000.00	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....
436.75	3,881.88S	.00366aa	.201P	.....	.....
457.61	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....
.....	.....	.....	17.8c.P	16c.P	18c.P
.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	1.25 per Gr. Sq.	92c. per Gr. Sq.
.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....
.....	.....	.....	.00035	.....	.00017
.....	.....	.....	.....	.....	.....
.....	.....	.....	17 to 35c.P	18c.PGG	.....
.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....
.....	.....	.....	$.156P	$.262P	.150P

Table

STREET CLEANING IN

City	Preventive Work		
	What Effort, If Any, Made to Secure Cooperation of Public to Reduce Street Litter?	Is Cost of Cleaning Considered in Selecting Kind of Pavement?	Do Police and Health Departments and Courts Cooperate?
Buffalo	By ordinance.	No.	Yes.
Beacon	Waste cans.	No.	Yes.
Binghamton	.....	.....	.....
Cincinnati	Through press and clean-up campaigns.	No.	Yes.
Cambridge	Cleanup Week.	No.	Yes.
Chicago	.....	.....	Yes.
Camden	Education campaign co-operating with civic organizations.	.....	.....
Columbus	.....	.....	.....
Cleveland	.....	.....	.....
Cortland	.....	No.	Some.
Dunkirk	.....	.....	.....
Denver	.....	.....	.....
Elmira	Waste cans used.	Not much.	Yes.
Fall River	No.	No.	No.
Grand Rapids	.....	.....	.....
Hudson	.....	Yes.	Yes.
Jamestown	.....	.....	.....
Kansas City	Superintendent arrests violators.	No.	Yes.
Kingston	.....	.....	.....
Los Angeles	.....	.....	.....
Louisville	Yes.	.....	Yes.
Lowell	.....	Yes.	Very little.
Lynn	.....	.....	No.
Lackawanna	Cleanup campaign.	Yes.	Yes.
Little Falls	None.	To some extent.	No.
Milwaukee	Publicity and circulars.	.....	Yes.
Middletown	Placed cans for paper. Through press.	Yes.	Yes.
Mechanicville	Police department and waste cans.	.....	Yes.
New York City	Anti-litter League Educational work.	.....	Yes.
New Orleans	.....	.....	.....
New Bedford	.....	.....	.....
Newark	Police department and public schools.	No.	Yes.
Norwich	Very little.	No.	No.
New Rochelle	Yes, by ordinance.	Yes.	Yes.
Niagara Falls	Placing waste cans.	Yes.	Yes.
Newburgh	Through press, cans provided, hand-bills distributed in business section.	.....	.....
Oakland	Distribute cards, enforcements of ordinance prohibiting dumping of refuse in streets.	Yes.	Only in extreme cases.
Oswego	Use waste cans.	.....	.....
Ogdensburg	.....	.....	.....
Philadelphia	Pamphlets distributed. Rubbish cards distributed, lectures to school children. Place waste cans.	In general way.	To some extent.
Providence	.....	.....	Yes.
Rochester	.....	.....	.....
Rensselaer	.....	No.	Yes.
Reading	.....	.....	.....
Richmond	.....	.....	.....
St. Louis	Placing metal refuse boxes on sidewalk.	Yes.	.....
San Francisco	Place dirt cans and paper cans.	.....	Yes.
Salt Lake City	Enforcement of ordinances	.....	Yes.
Springfield	.....	.....	.....
Seattle	Through the press.	.....	Yes.
Scranton	.....	.....	.....
Troy	.....	.....	.....
Utica	.....	.....	.....
Washington	Placing waste paper boxes, police regulation.	No.	Yes.

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AMERICAN CITIES (Continued)

Any Unusual Conditions with Which Your Department Has to Contend?	Disposal of Sweepings						
	Average No. of Cu. Yds. of Sweepings per 1,000 Sq. Yds. of Area Cleaned	Average Amount of Sweepings Collected at Each Cleaning	Method of Disposal				
			On City Dump	Used for Filler	Sold for Fertiliser	Price Charged	Total Yearly Receipts
None.	.....	.....	Yes.	Yes.	.....	.....	.....
No.	.....	.....	.....	.....	Yes.	Contract.	$137.00
.....	.....	.....	.....	.....	.....	.....	.....
Land slides and floods.	.24.	.....	Yes.	Yes.	.....	.....	.....
No.	.....	.....	Yes.	.....	.....	.....	.....
.....	.079.	.079.	Yes.	Yes.	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	Yes.	.....	.....	.....	.....
Some lanes in rear of stores used for dumping papers.	.....	.....	Yes.	Yes.	.....	.....	.....
.....	.....	.....	Yes.	.....	.....	.....	.....
.....	.....	.....	Yes.	.....	.....	.....	.....
No.	.....	.....	.....	Yes.	.....	.....	.....
No.	.....	.....	Yes.	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....
Existence of alleys.	½ cu. yd.	.....	Yes.	Yes.	.....	.....	.....
City very hilly.	.053.	.....	.....	.....	.....	.....	.....
No.	.....	.....	Yes.	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	Yes.	.....	.....
.....	.....	.....	Yes.	.....	.....	.....	.....
Papers from refuse collectors.	.....	.....	Yes.	.....	Yes.	.....	.....
No.	.....	.....	Yes.	.....	Yes.	.....	.....
.....	.....	.....	Yes.	.....	.....	.....	.....
No.	.....	.....	Yes.	.....	.....	.....	.....
No.	.....	.....	Yes.	.....	Yes.	80c. for 1½ yds.	.....
No.	.....	.....	.....	Yes.	.....	.....	.....
Construction work; push carts.	28.6 per yr.	.029 cu. yds.	.....	Yes.	.....	.....	.....
.....	.....	.....	Yes.	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....
No.	.....	.....	.....	Yes.	.....	.....	.....
No.	.....	.....	Yes.	Yes.	.....	.....	.....
No.	119 cu. yds.	.....	Yes.	.....	.....	.....	.....
No.	.....	.....	Yes.	.....	.....	.....	.....
.....	.....	.....	Yes.	.....	.....	.....	.....
None.	.....	.....	Yes.	Yes.	.....	.....	.....
No city garbage or ash collection; people dump on back streets.	.....	.....	Yes.	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....
Overloaded wagons, storekeeper sweeping dust into street.	.17.	.23 cu. yds.	Yes.	Yes.	.....	.....	.....
.....	.....	.....	Yes.	Yes.	.....	$2.00 per cord.	.....
.....	.....	.....	.....	.....	.....	.....	.....
No.	.....	.....	Yes.	Yes.	Yes.	No.	.....
.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	Yes.	Yes.	Yes.	15c. per load	.....
.....	.....	.....	Yes.	Yes.	.....	.....	.....
.....	.....	.....	Yes.	.....	.....	.....	.....
.....	.....	.....	Yes.	Yes.	.....	.....	.....
.....	.....	.....	Yes.	.....	Yes.	No.	.....
Many hills.	.....	.....	Yes.	Yes.	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	Yes.	Yes.	.....	.....	.....

NOTE: Seattle and Denver are the only cities which report that they clean their sidewalks. Denver limits its work to the business district. All cities report they do not dump sweepings in manholes. All cities except Salt Lake City and Norwich report they sprinkle streets preceding sweeping. Cambridge, San Francisco, and Springfield, Mass., are the only cities which report they do not have sprinklers preceds squeegee machines.

A Flushing only.
B Sweepers patrol streets from one to ten times daily.
C On account of favorable weather conditions and the necessity of economising very little machine brooming is done.
D Entire year.
E Four of these on the average will be sub-foremen at $3.50, and the other laborers at $2.50 for 8 hours. These men are also under the supervision of four district deputies at $125 a month each. These district deputies have many other duties.
F One-tenth of it cleaned four times daily. Two-fifths once a day. One-half once a week.
G Not including alleys.
H Hand cleaning, flushing and squeegeeing.
J Hand and machine sweeping and flushing.
K 43,341 loads in year; 85% 2 cu. yds. each and 15% 3 cu. yds. each.
L Flushing only.
N One square equals 540 ft. including salaries and wages, cost of new appliances, repairs and maintenance of appliances and all other overhead charges.
Including 10% of cost of machinery for depreciation and repairs and 4½% interest on machinery.
P Per 1,000 sq. yds.
R Includes depreciation and repairs, but not general supervision.
S On city work only. Does not include amount paid to contractor.
T For water and oil.
V .045 foot frontage for 40 foot street.
.055 foot frontage for 50 foot street.
.065 foot frontage for 60 foot street.
AA Includes cleaning drains and gutters and inlets, cleaning under small highway bridges and removing fallen trees from roadway.
CC Based on street 30 feet wide and sprinkled twice daily for 150 days.
DD City also paid for water and hydrant rental $25,329.88
EE Railroad company furnishes electric power and use of tracks for car sprinkler and power flusher. City pays for car.
FF City furnishes two men and company motormen and conductor. City owns sprinklers.
GG Trolley car flusher.
HH Does not include depreciation and interest.
* Length of day eight hours, unless otherwise noted.
MM Also includes machine sweeping, cleaned periodically.
NN Also includes machine sweeping—per year.

SEWAGE DISPOSAL

SEWAGE DISPOSAL

EFFICIENCY OF PROCESSES USED BY AMERICAN CITIES—OPINIONS OF AUTHORITIES—EXPERIMENTS WITH NEW METHODS.

RECOGNITION of the necessity for the proper disposal of sewage is now quite prevalent in most American communities, whether large or small. In many sections the problem has become vital, and as the population increases, it is only a matter of time when all will be compelled to solve the problem, for its importance grows in direct proportion to the rapid increase in inhabitants. The continued concentration of population makes it increasingly difficult and expensive for a municipality to secure and maintain a pure water supply and forces community activity for protection against disease germs. It also causes the demand for the improvement of the esthetic condition of bodies of water within or near a city's boundaries. Many states have already recognized the conditions due to these nuisances and have enacted strict legislation with a view to preventing the pollution of streams and other bodies of water, for the protection of water supplies, surface and underground, and for the elimination of disease germs accompanying sewage. States and even nations have realized that sewage disposal is more than a local problem. In every case it is an inter-community problem, in some it is inter-state and in a few the question must be settled by national governments.

Even those communities which have not already provided a proper method of disposal of their sewage know that it must be done sooner or later, and many are preparing for it either by making a preliminary study, by

preparing tentative plans, by reconstructing their sewerage systems or planning new extensions with that end in view, or by shaping their financial programs so that the community will be prepared to assume the financial burden when the necessity becomes imperative.

The quantity of harmful waste produced by a community is surprisingly small in comparison with the disastrous effects it may produce. All authorities agree that in cities provided with an abundant water supply sewage contains less than one-tenth of one per cent. of foreign substances. This organic matter and the products of its decomposition the Massachusetts State Board of Health has found rarely exceed one-half of one per cent. of the sewage. George W. Fuller, consulting sanitary engineer, says that 99.9 per cent. of sewage is ordinarily pure water and that even much of the remainder is harmless matter of a mineral nature. The experience of George S. Webster, Chief Engineer of the Bureau of Surveys and of the Philadelphia Sewage Testing Station, with sewage works, indicates that on an average 1,000 persons produce per annum forty-five tons of dry sludge matter, or the solid part of the sewage after treatment; and the United States Census Bureau reports that the volume of sewage discharged daily during the year per person is 164 gallons. Yet the small amount of decomposing matter must be properly treated for it is that which gives sewage its offensive character and power to cause disease.

The proper solution of the sewage disposal problem involves first, the construction of a sewerage system that will remove the sewage from the community completely and as rapidly as possible, and secondly, the construction of a disposal plant at which the sewage can be treated in such a way that when it is discharged into the body of water it will not cause a nuisance and disease.

The Sewerage System

There are two types of sewerage systems in use, the separate and the combined. In the former the storm water is removed in one set of pipes and the domestic sewage in another. The combined system removes both in the same set of pipes. In deciding which system to adopt three factors must be first considered, the cost, the topography of the city and the method of disposal. The general conclusions of sanitary engineers at present regarding the relative merits of the two systems are that either is satisfactory from a sanitary point of view when properly constructed, that the separate system is usually best for suburban districts not closely built up and for all communities where the sanitary sewage requires treatment, and that often a combination of the two systems can be used to advantage. Most engineers point to the advantage of combined sewers in narrow streets and congested districts where only one pipe and one house connection are required.

The belief has been expressed by John H. Gregory, consulting engineer, that as a general proposition the cost of building a combined system is less than that of constructing a separate system, especially where the territory to be served is more or less closely built up and streets paved. In suburban territory, not closely built up and where storm water is easily and quickly diverted into natural water courses, he believes the separate system will in general cost less, for then only sanitary sewers need to be built first, the storm water sewers being deferred for years or only such drains constructed as are immediately required. When there are steep grades and relatively high velocity all authorities agree with Gregory that it is advisable to build combined sewers, even though the development of the territory may hardly be such as to require the removal of the storm water.

Discussing the merits of the two systems so far as they

affect the cost of disposal Clark P. Collins, sanitary engineer, concludes that generally speaking "it is unwise to dilute sewage with storm water and to befoul storm water with sewage in the attempt to remove both by the same underground channel." Gregory has expressed the opinion that if sewage is to be discharged into a body without treatment the combined system will offer the simplest and cheapest solution of the problem.

Among the principal objections to the combined system when the sewage is treated are the increase it causes in the volume of liquid which necessarily requires a larger plant and expenditure, the changes it causes in the character of the sewage which complicates operation of the plant, and the frequency with which it causes the flow of sewage to exceed the maximum of the plant, thereby making it necessary to discharge untreated sewage into the stream. With a combined system all kinds of trade wastes must be run through the disposal plant, whether they are offensive or not; automatic devices, which should be avoided whenever possible, are necessary between the combined and intercepting sewers to limit the amount of flow; a greater amount of grit is deposited at the disposal works unless in the separate system the first wash of the street is intercepted. The New York State Board of Health advocates the separate system.

In constructing, extending or reconstructing a sewerage system it is well to bear in mind that even though a city has not at present a disposal plant, the time will come in all probability when increased population will compel the treatment of its sewage by some process. It may, therefore, be more economical eventually to make present plans so that when disposal does come the sewerage system will make possible the most economical operation of the disposal works. Gregory's conclusion as recently expressed in an address is that "other things being equal, especially as more

and more attention is being given to sewage disposal, the separate system seems to offer greater advantages."

All engineers advocate good ventilation for sewers and gradients that will develop self-cleansing velocities, so as to reduce gas trouble and to deliver the sewage as fresh as possible to the disposal works. The best practise, according to reports of the State Boards of Health, show that these velocities should be not less than two feet per second in separate systems and two and one-half feet in combined systems. In some instances where it has been necessary to reduce the gradients because of the expense of obtaining steeper ones, a velocity of one foot per second has been found to be satisfactory; but in such instances sewers must be well constructed and flushed. Most trade wastes require a higher velocity to prevent deposits.

The Degree of Purification of Sewage

Before determining the proper method of disposal the first point to be settled by a city is the degree of purification desired or needed for both the present and the future. The decision is dependent upon three factors: the self-purifying capacity of the stream or body of water into which the effluent—liquid portions of the sewage run off after treatment—is to be discharged and its utilization for water supply, bathing, etc., the character and amount of the sewage and the possible future growth not only of the city itself, but also of the communities bordering on the stream. While there have been some demands for the absolute sterilization of sewage, many sanitarians believe that any artificial method of sewage treatment will not esthetically render the final effluent fit for ingestion, and practically all authorities agree that final discharge of sewage need not be in this perfect condition. This seems to be based on logical reasoning when one considers that all waterways are necessarily polluted to some extent. John Duncan Watson, of Birmingham, England, contends that the complete elimina-

tion of bacteria is prohibitive inasmuch as it is beyond the limits of the reasonable demands on the purse. Robert Spurr Weston, member of the American Society of Civil Engineers, at one time reminded an audience that the proper place to protect the water consumers against disease is at the water works and not at the sewage disposal plant. Authorities are in general agreed that sewage should be disposed of as the stream demands, and that local conditions should determine degree of purification required. Standards of purity have been studied by many societies and various suggestions have been made. All agree that the sewage after treatment should not deteriorate the stream into which it flows. Watson advocates under certain conditions an effluent that will not putrefy on being kept for seven days at a uniform temperature of 80 degrees F. and that does not contain more than three parts per 100,000 of suspended solid matter.

Generally speaking the suspended matter should be removed, the conditions near the point of discharge be inoffensive and the water be not impaired for purposes of manufacture and pleasure. When a city is located on the seashore or near a large lake or stream the screening out of the heavy particles before the sewage is discharged together with dilution will prevent active decomposition and putrefaction of the sewage the body of water receives and the esthetic senses of the community will not be offended. On small bodies of water and when the water is used for drinking and manufacturing purposes or for bathing or shellfish the conditions usually demand not only a nonputrescible effluent but also one that is free from harmful bacteria or one that is highly purified like that from sand filters.

There seems to be a general agreement among sanitary engineers that the condition of the river below where the effluent joins it is a safe guide and should be the ruling factor in determining the degree of purification desirable.

Authorities, however, are not agreed as to whether the standard of cleanliness should be based solely on chemical analysis or on a mixed standard taking into consideration the appearance of the water and its physical, chemical and bacterial conditions, as has been demonstrated by the Metropolitan Sewage Commission of New York. One expert in answer to the question propounded by the Commission based the standard solely on chemical analysis, but none of those whose views were sought was willing to accept the dissolved oxygen test as an all sufficient criterion of the condition of the water. One considered that the oxygen should be regarded as a reliable index of the cleanliness of the water only when dealing with the condition of gross pollution and only when in conjunction with observations of the appearance and physical conditions of the water. One of them would not have a standard of cleanliness based solely upon analysis of any kind and all were agreed that the standard of cleanliness should not rest upon the effect of the polluted water upon health.

After having decided on the degree of purification the next step in the solution of the problem is to select the process of treatment best adapted with local conditions to produce the results at the lowest cost and without nuisance. No specific rules can be laid down for the selection of the best process for all communities. Domestic wastes offer the least difficulty, but they are usually complicated with the presence of trade or street wastes or both. Features difficult to overcome may then be produced. Then also, the character of the sewage varies greatly with the season, days and even hours. This is due to the habits of the people, to climatic conditions and to the amount and character of trade and industrial wastes and to the amount of water used and allowed to infiltrate. A cannery, creamery, tannery, brewery, strawboard factory, wool scouring shop, dyeing and cleaning works may discharge its wastes so that during a certain period the character of the sewage be entirely

changed. Knowledge of these conditions and changes are necessary to plan a successful disposal plant. Each community has its own problem, and while there are certain general conditions that should be considered, each case is more or less unique. Charles G. Hyde, consulting engineer of the California State Board of Health, has summed up the situation in this statement: "It is folly to suppose that because one town can dispose of its sewage successfully in some certain fashion, another town can adopt the same method with a certainty of securing equally satisfactory results. Sewage differs widely in character, not only as between towns but in a given town."

Processes of Treatment

The processes for treating sewage may be divided into three main groups—the preliminary or preparatory, the main or final, and disinfection.

The processes in the preliminary or preparatory group remove more or less of the solids, especially the suspended matter, but the effluent, or liquid that is discharged into the stream, is chemically unstable and will decompose and putrefy. These are the simplest methods of treatment, and, except when sewage is discharged into very large bodies of water where it is desired only to improve the esthetic condition or where the water is capable of rapid self-purification, at least one of these processes is used in combination with some other form of treatment in the next group. The preliminary processes are dilution, screening (coarse or fine), plain sedimentation, straining or roughing filters, chemical precipitation, slate beds, colloidal tanks, septic tank treatment, and single contact beds.

The main or final processes are more complex. These remove a substantial proportion of the dissolved and suspended matter. The effluent is generally stable. When any one of these processes is used it is customary to provide some preliminary treatment. The processes in this

group are double contact beds, trickling (also called percolating), sprinkling filters, intermittent sand filtration and broad irrigation or sewage farming.

In the third group is the process of disinfection, either by hypochlorite of lime or liquid chlorine. Some authorities call this third group the finishing process and preface two others, secondary settling tanks and secondary filters. The chemical elements of this group destroy the bacteria, especially the disease producing kind, and are used in combination with one or more of the processes in the other two groups to produce a highly purified effluent.

Several other processes have been developed within the last few years. The electrolytic process is now being used in a few American cities, and has been included in almost all of the experiments now being made by municipalities. The activated sludge process has been adopted by two large cities, Milwaukee, Wis., and Houston, Texas, and two small cities, San Marcos, Texas, and Escanaba, Mich., and is being tested in at least eighteen others, among them Baltimore, Cleveland and Brooklyn. Jersey City, N. J., has tentatively adopted the activated sludge process. Another process, known as the Miles Acid Sludge Process, is being experimented with by the city of Boston.

These processes or variations of them may be used singly or in combinations of two or more to yield different degrees of purification that will meet varying local requirements. Which of these or what combination of processes to use according to local requirements is the all important question for a city to answer. Several cities either have adopted or are planning to adopt the plan advocated by John A. Giles, Commissioner of Public Works of Binghamton, New York, to include a number of the different stages of treatment in the original design so that when future installation is necessary on account of increased population, with its increased pollution, or the need for a greater degree of purification becomes imperative, the addition can be made

on the site already provided for and each unit will fit into the complete structure at a minimum cost. The consensus of opinion is that a disposal works can be designed and constructed which will produce an effluent that will not deteriorate the water into which it is discharged, that will create no nuisance from odor or from flies and that the cost will be strictly proportionate to the sanitary and esthetic results achieved.

An approximate idea of the efficiency of the various well known processes in the removal of bacteria was given by Professor George G. Whipple, Professor of Sanitary Engineering, Harvard University, before the New York State Conference of Mayors and Other City Officials:

Process	Percentage of Bacteria Removed
Fine screens	10 to 15
Settling tanks	60 to 70
Septic tanks	60 to 70
Chemical precipitation	80 to 90
Contact filters	75 to 85
Percolating filters	85 to 95
Intermittent sand filters	95 to 99
Broad irrigation	95 to 99

Dilution

Comparatively few cities can much longer depend upon large bodies of water to dilute their untreated sewage. Even those cities located on the seacoast and on the banks of large rivers and lakes have either provided some method of treatment, usually one or more of the processes in the preliminary group, or are planning to do so. New York City which has an adjacent large body of water into which it discharges its sewage without treatment of any kind, now finds it necessary to adopt a combination of processes to eliminate the nuisance the waste is causing. In some places where dilution is depended upon, the existing nuisances have been caused by the outlets being extended only to the high water line of the water course, thus preventing a

proper mixture of sewage with a sufficient volume of water adequately to dilute it. Other difficulties experienced when untreated or raw sewage is discharged into large volumes of water in excessive quantities are the formation of deposits of sludge, the residue after sewage has been allowed to settle, on the banks and the bottom; turbidity, milkiness and oiliness of the water, bad odors, the formation of scum upon the water and the destruction of shellfish. To overcome these difficulties some cities have resorted to dredging, screening and sedimentation. Others have been compelled to adopt some more complicated process.

The California State Board of Health in one of its bulletins quotes its consulting engineer, Charles G. Hyde, as saying that experience has demonstrated rather definitely that a nuisance will be caused if sewage is diluted with less than about twenty volumes of water while from forty to fifty may in some cases be necessary. Weston believes that in ordinary cases mixtures of sewage and water should be fifty per cent. saturated with oxygen, and when there is an excessive deposit of sludge even seventy per cent. of saturation may be insufficient. Herring and Gregory, in their report on the Albany, New York, system, say: "From observations made in many rivers it has been found that a flow of well oxygenated river water of from three to six cubic feet per second is capable of diluting the sewage from a population of 1,000 to a degree that will allow oxygen in the river water to oxidize the easily putrescible organic matter in the sewage and thereby prevent the water from becoming offensive, provided the velocity of flow is sufficient to prevent accumulations of sewage sludge on the bottom of the stream."

Screening

The screening process consists of running the sewage through coarse or fine screens, either hand cleaned or mechanically operated, to remove suspended and floating matter. There is almost an unanimity of opinion now in favor

of the use of mechanically operated fine screens. The efficiency depends largely although not entirely, upon the size of the mesh or openings through which the sewage passes. Coarse screens, which are cleaned by hand, will remove from two to ten per cent. of the suspended matter and fine screens which are mechanically operated will in some cases remove as much as 25 per cent. Screening will not materially change the turbidity of the liquid or the greasy appearance nor will it remove all of the suspended matter.

Experience has shown that the screening process is valuable in connection with sewage pumping works and inverted siphons, when sewage is disposed of by dilution and when raw sewage is applied without any other preliminary treatment to a final process as it prevents the clogging of machinery and filters.

When the process is used the screenings must ordinarily be disposed of within twenty-four hours on account of fermentation and decomposition which sets in quickly. In some cities the deposits are buried and in others they are burned after having been artificially dried. Robert Spurr Weston says that it seems unwise to attempt to dispose separately of two kinds of sludge, namely that removed before and that remaining after subsidence. "On the other hand," he continues, "the screening of the effluent from a settling tank in order to reduce the operative charges for cleaning sprinklers is an economical practise. Furthermore, the actual amount of material screened from the effluent is small in comparison with that removed from unsettled sewage and its subsequent disposal is not a serious burden."

Grit Chambers

If a sewage disposal plant is operated in connection with a combined sewerage system grit chambers are usually necessary for the removal of sand, gravel and dirt before the sewage passes on for further treatment. Where a city has a separate system of sewerage grit chambers are held by

some authorities to be unnecessary unless the first wash of the street after a storm is intercepted and the waste is treated. Gregory has expressed the belief that the safest plan under ordinary conditions seems to be to provide a grit chamber. It is generally agreed that the chambers should be so constructed that the sewage will flow through slowly enough for the grit to settle out, but fast enough to carry the organic matter in suspension. To insure proper operation the chamber must be cleaned out frequently. At the Cleveland Sewage Testing Station it has been found that velocities ranging from 30 to 60 feet per minute produce a grit of proper character. The California State Board of Health has advocated chambers with a capacity such that a net period of storage of at least three minutes be allowed and a velocity of not less than five feet per minute.

Straining or Roughing

There are few cities which treat their sewage by the process of straining and roughing. This consists of removing the suspended matter by means of rapid straining through beds of coke or sand arranged like the rapid sand or mechanical water filter. Coke beds, especially in cold climates, have not been a success. The chief objection to the rapid sand filter is the wash water which contains much organic or mineral impurities of the sewage and which requires special treatment which experience has shown to be difficult and expensive. Difficulty has also been found in disposing of the sludge deposited upon the filter surface. Of this process the bulletin of the California State Board of Health says: "The process is an expensive one at best, both as respects construction and operation. The effluent from such works can be made fully equal to, if not better than the effluent of plain sedimentation basins from a sanitary point of view." The experience of the Cleveland Testing Station with these filters was not favorable. The filters when operated at rates from 30 to 60 gallons per acre per

24 hours removed from 25 to 40 per cent. of suspended matter and their action was simply mechanical, there being no increase in the dissolved oxygen content. The report from the station says that the difficulties encountered in their operation were sufficient to eliminate the process as a method in itself or in combination with other processes.

Treatment in Tanks

The treatment of sewage in tanks, either by chemical or biological processes, has been adopted by many cities, especially as a preliminary treatment. These processes are known as plain sedimentation, chemical precipitation and the septic process. Of these the treatment in the Imhoff tank is the most popular at the present time.

Plain Sedimentation

By allowing the sewage either to flow into properly constructed tanks or through them at a velocity low enough to allow some of the suspended matter to separate from the liquid and to be deposited on the bottom from which the sludge is removed, is another process that has been used by a number of American and European cities. The first tanks were constructed so that they could be filled with sewage and then after the suspended matter had settled the effluent was drawn off. This was known as the fill and draw plan. Later what is now known as the continuous flow principle was used. The velocity of the flowing sewage is reduced sufficiently as it enters and passes through the tank for the suspended matter to settle. The sludge which collects at the bottom of the tank must be removed frequently. The results are affected by the quantity and quality of the sewage, fresh sewage being capable of greater clarification by sedimentation than stale sewage. The range in storage period for American sewages is from four to twelve hours and the removal of suspended matter is from 45 to 75 per cent.

In some cities plain sedimentation has been used in connection with dilution and in others as an aid to filtration. The chief objection to the process is the sludge which is extremely offensive and must be treated separately. It does not dry readily, is difficult to handle and if allowed to accumulate causes serious nuisance. Because of these difficulties and the fact that the sludge from the Cameron and Imhoff tanks can be more easily disposed of the septic process has gradually forced plain sedimentation into the background.

Colloidal tanks were designed to carry the process of clarification further than plain sedimentation, but they have not come into general use. Metcalf and Eddy in their "American Sewerage Practice" say of this process: "There has been a feeling that while under some conditions a portion of the colloidal solids could be removed by such devices, the work accomplished was not likely to be sufficient to offset the expense of construction and some difficulties in operation."

The Septic Process

In the septic process the raw sewage is conveyed to tanks, and allowed to stand until the solids have settled to the bottom and have been partially destroyed or liquefied by bacterial action. Two types of tanks are used in the septic process, one known as the Cameron type and the other as the Emscher or Imhoff tank.

The best constructed Cameron tanks are not less than 8 feet in depth and are usually large enough to hold about six hours' maximum flow of sewage. The desirable time of detention depends upon the character of the sewage, both as to strength and freshness, strong and stale sewages demanding a longer period. The tanks are usually built with baffles at the entrance to retard the current and to deflect the suspended matter to the bottom which is so constructed that the sludge, after bacterial action has taken place, can be drawn off from time to time.

H. W. Clark, formerly chemist of the Massachusetts State Board of Health, has expressed the belief that the rate of flow through a septic tank should not be greater than that which will cause passage in twelve hours.

Charles G. Hyde in the California Board of Health Bulletin says that as a rule the period should not be greater than 24 hours nor less than 12 hours, except possibly with weak or stale sewages. He advocates multiple units so that the storage periods may be controlled to give optimum results.

The effluent which is turbid, putrescible and rich in organic matter cannot be discharged into streams with safety without further treatment, unless the volume of water is sufficient to complete the purification by dilution. As the solids settle a scum which forms on top of the tank, keeps out light and air and produces a condition favorable for the bacterial activity caused by minute organisms known as anaerobic bacteria. These germs thrive and functionate best in the absence of oxygen, and their chief function in sewage treatment is the conversion of the solid organic matter into a soluble form, somewhat less complex in chemical composition. The sludge is rotted and when full bacterial action has taken place is humified. In plain sedimentation the solids are simply deposited upon the bottom of the tank and are removed practically unchanged. In the septic tank, however, a part of the solids after settling are broken down or digested, thus somewhat lessening the difficulty of disposing of the sludge.

Reports vary widely as to the amount of suspended matter that can be removed by the septic process. The Iowa State College bulletin says that the amount of purification does not usually exceed 25 to 40 per cent. Professor Whipple places the removal between 60 and 70 per cent., and the State Board of Health of California says it may vary between 35 per cent. and 85 per cent., averaging perhaps 50 to 60 per cent. H. W. Clark places the amount at not less

than 40 per cent. and adds that it will vary according to the character of the sewage, the variations being from 30 per cent. with weak sewage to 80 per cent. with strong sewage.

All reports concur that in many cases the Cameron type of tank has failed to produce efficient results. Among the objections raised by authorities are the following:

The sludge is not thoroughly digested and is somewhat offensive. The odor is obnoxious and the effluent is too stale and is treated with difficulty by oxidation processes. Gilbert J. Fowler, Sanitary Expert of England, says the defects which have shown themselves are a nuisance both from the tank effluent and the sludge and an excessive quantity of suspended solids in the tank effluent. Charles G. Hyde believes a review of the principles and results of operation appear to justify the conclusion that "the septic effluents are only less dangerous than crude sewage to the extent of efficiency of removal of organic matter."

The Imhoff Tank

In an effort to overcome the defects in the Cameron tank, the Imhoff or Emscher tank was developed and this now seems to have the preference among cities making new installations. The tank consists of two compartments, one above the other. It has a smaller area than the ordinary septic tank, but is much deeper. The sewage passes at a low velocity through the upper chamber, which is comparatively shallow and V-shaped, the sides being sufficiently steep to allow the solids to be deposited at the bottom of the V which is equipped with slots. Through these the solids pass into the second chamber below which is much deeper than the other. The inclined partition wall must be cleaned frequently with hose or squeegee in such a way as not to clog the slots. The floating pieces of wood and cork must be skimmed off, but the greater part of the suspended matter that floats will generally sink after a time. Dr. Karl Imhoff, the inventor of the tank, advises spraying with a

hose to expedite the sinking. Care must be taken to keep the sides clean and the sludge in the lower tank below the slot level. If neglected suspended matters will rise to the surface behind as well as in front of the scum boards. Dr. Imhoff advises the reversal of the flow of sewage about every three weeks after skimming off the floating matter when one sedimentation chamber feeds more than one sludge chamber. The rate of flow in the upper chamber is sufficiently rapid to prevent any septic action, yet slow enough to allow much of the suspended matter to settle.

The effluent in a comparatively fresh condition passes out of the tank for further treatment or for discharge into water courses. It therefore does not become stale nor does it come in contact with decomposing sludge, thus eliminating in part the objections advanced by authorities against the Cameron tank.

In the lower tank the sludge, after passing through the slots is slowly digested through septic and other actions without any disturbance by the flow of the liquid sewage, above. Before the tank can deliver good, well digested sludge—that is, a black alkaline odorless sludge—it must be inoculated with a proper amount of good sludge, or the raw sludge must be permitted to "ripen." Dr. Imhoff has found that even without inoculation a tank will discharge good sludge from the beginning if ripe sludge is emptied into the system from cesspools which have been in use a long time.

In some instances cities have had considerable trouble with acid decomposition during the ripening period. This produces a sludge of objectionable odor and one not easily dried. It decomposes very slowly and may rise in a mass to the surface of the sludge chamber. Various remedies have been suggested, among them the addition of lime. "I cannot advise such addition," Dr. Imhoff has written. "All plants which are known to me and in which acid decomposi-

tion has occurred have sooner or later adjusted themselves of their own accord."

When properly inoculated the particles of sludge rise and fall constantly in the process of giving off the gases. The fresh sludge particles entering the chamber through the slot are covered so that the entire mass becomes thoroughly mixed and the untreated sludge in a short time is inoculated with the proper organisms. The decomposed sludge is discharged from time to time through pipes leading from the bottom of the tank to drying beds.

Dr. Imhoff has advocated the discharge of sludge from each sludge chamber once every two to six weeks, that the optimum of the sludge level should be about three feet below the slot level and if it is desired to promote the early incidence of proper decomposition the sludge should not be allowed to remain quiet at the bottom of the sludge chamber. He advocates constant stirring and a uniform introduction of fresh organic matter and the discharge of the decomposed matter. The scum layer, he says, must be agitated frequently by a jet of water or otherwise and the sludge at the bottom of the chamber should be agitated by a water stirring system. As a substitute, he suggests that the whole body of sludge be pumped out and returned. To determine the elevation of the sludge surface, he advises lowering into the sludge chamber a very thin piece of sheet iron one foot square in area held in a horizontal position. If the level is too high, there will be gas bubbles on the surface of the settling chamber above the slot or there will be floating sludge and in extreme cases foaming sludge. As compared with other tank processes the experience of cities indicates that the Imhoff type has many advantages. Certain inherent difficulties, however, have been pointed out in several reports. Gilbert J. Fowler has expressed the belief that "the comparative short time of settlement means that variations in the character of the sewage must be quickly reflected in the character of the tank effluence and that

the filters (when they are used for further treatment) must be called upon rapidly to accommodate themselves to fluctuating conditions." He believes that this is not conducive to the development of the most efficient bacterial activity. Storm water above moderate dilution, he says, will have to receive separate treatment and he is of the opinion that ordinary stand-by tanks will still be necessary for this purpose, the sludge from which will have to be dealt with. From the results of the operation of an experimental plant in Worcester, Massachusetts, Matthew Gault, Superintendent of Sewers, draws these conclusions: "It appears to be perfectly feasible to treat Worcester sewage by means of Imhoff tanks and sprinkling filters. The results of experimental treatment of the effluent from chemical precipitation tanks indicated that the advantages gained by chemical precipitation as a preliminary treatment were not commensurate with the cost. The Imhoff tank was quite as efficient in sludge digestion as experimental septic tanks have been and much more efficient so far as sedimentation of the sewage is concerned. It was operated without the production of the offensive odors characteristic of the septic tank and the sludge itself was disposed of without creating a nuisance. The effluent from the Imhoff tank was normally as fresh in appearance and odor as the sewage flowing into the tank."

The experience of the New Jersey State Board of Health with Imhoff tanks has been that if properly designed, constructed and operated, they are a valuable means of sewage clarification. The observation of its engineers has shown that under these conditions the tanks overcome a great deal of trouble due to odors and greatly simplify the sludge problem. "However, their proper operation is a considerable problem," reads one of its reports. "And the cost of keeping them in working order is several times greater than for septic or sedimentation tanks." In view of the initial cost of this form of tank as compared with

the older single story types the New Jersey engineers believe that "in cases where the works are far removed from a populous community, so that the odor problem is not serious, it is doubtful whether the Imhoff tank has any material advantage over a properly constructed, well baffled sedimentation tank of the old type."

The Cleveland Sewage Testing Station reports that the most consistent results were obtained from the operation of the Imhoff tank, an average suspended matter removal of 50 per cent. being secured. A recent city report says: "In general it may be said that a detention period of thirty minutes accomplished a removal of suspended matter from 40 to 45 per cent. as compared with a 50 per cent. removal effected by a detention period of two hours and fifteen minutes."

In a bulletin of the California Board of Health, Charles G. Hyde sums up the importance of the septic process thus: "The septic process as carried out either in the Cameron or Imhoff type, but especially in the latter, has at present two distinct fields of usefulness; first, it constitutes an effective means of preparation for any final process which can be better conducted with a sewage from which the suspended solids are more or less completely removed; secondly, it may be employed when disposal by dilution is permissible if the source of unsightly sludge and scum is removed." Another advantage may be added, the Imhoff tank produces a sludge that can be disposed of easily.

Chemical Precipitation

By using some coagulant such as copperas, lime, sulphate of alumina or perchloride of iron, the subsidence in basins of between 40 and 55 per cent. of the total organic matter and between 60 and 95 per cent. of the total suspended matter can be obtained. The bacterial removal is between 80 and 90 per cent., depending upon the character of the sewage. The objections to this process are great

cost of chemicals and labor required and the difficulty of disposing of a large amount of sludge. There are a few plants of this kind in operation at the present time and there seems to be a general agreement among authorities that the process is now a back number. Fowler says, "It may be doubted whether dilute sewages resulting from the lavish use of water in American cities lend themselves generally to economical treatment by this process." Metcalf and Eddy in their "American Sewerage Practice" express the opinion that the quantity of chemicals required for results would be a prohibitive expense. The sewerage commission report of New Jersey contains the statement that "on the standpoint of the officials in charge of the experimental station at Lawrence, Massachusetts, chemical precipitation is a process of the past." The experiments of the Massachusetts State Board of Health showed that it is quite impossible to obtain effluents by chemical precipitation which compare in organic purity with those obtained by intermittent sand filtration. About the only plants of any importance in the United States are those at Worcester, Massachusetts, and Providence, Rhode Island. According to the report of the Superintendent of Sewers of Worcester, the experimental plant in that city has shown that "the cost of operation of Imhoff tanks and sprinkling filters per million gallons of sewage treated would be much less than the cost of operation of chemical precipitation or sand filtration as carried on in Worcester."

Slate Beds

The equipment for this process consists of tanks with horizontal slabs of slate separated a few inches by stone blocks. The sewage is allowed to stand in the tank for about two hours, during which the suspended matter is deposited on the slabs and is digested by multifarious forms known as aerobic germs, *i. e.*, germs requiring oxygen for the continuance of their proper vital function. The de-

posits are thereby reduced to harmless and inoffensive humus. Slate beds are dosed and rested alternately so as to give them an opportunity to replenish their supply of oxygen. Multiple units are therefore necessary. The effluent must be treated as a tank effluent. Fowler suggests that when filters are used to purify the effluent, "humus" tanks be provided between the slate and the filter to retain the solids washed away from the beds and somewhat to equalize the composition of the effluent passing into the filter.

Dosing Chambers

After the effluent has passed from a tank after being treated by one or more of the preliminary processes, it usually flows into a compartment known as the dosing chamber where it is admitted to the filter for further purification.

When enough of the liquid has accumulated in the chamber it is automatically emptied by means of a siphon, thus permitting the intermittent application of the sewage to the filter bed. When more than one bed is used the siphons are arranged so that the liquid alternately flows to different filters or parts of filters.

Contact Filters—Single and Double

The treatment of sewage in a single contact filter is classed as a preliminary process and when treated in double contact beds or those arranged in tandem as a final process. A contact filter is a basin filled with broken stone, coke, slag or coarse gravel, thoroughly under-drained. The size of stone or other material to be used depends upon the degree of purification desired, and the manner of operating the beds. The smaller the stone the more brilliant the effluent will be, but all reports agree that the cost of operation will be greater and that there will be a more rapid loss of filter capacity. Experience has taught the superiority of the coarser material because the interstices being so large the

bed is not so liable to choke. Watson advises a fine medium bed only when a highly purified effluent is desired, when it would be difficult to get rid of humus from the filtrate, when a high cost of maintenance is not prohibitive and when a temporary stoppage of the whole plant would not be a serious matter. He believes it is not suitable for installations of any magnitude. Beds have been built with various depths, the range being between four and seven feet. Some have been built shallower and have given good results. The method of applying the sewage is important. Some tanks are overfed and others are underfed. Francis E. Daniels, Director of Water and Sewage Inspection of the New Jersey State Board of Health, describes a method which has been found to be successful in plants in this state. At these plants the effluent is applied on the top and at one corner of the contact beds. At the point of application a small area of contact material from 6 inches to one foot deep is removed from the top of the bed, and fine cinders are substituted. An embankment about a foot high is constructed of the same material around this area so that all of the tank effluent applied to the beds strains through the cinders. Mr. Daniels says that a great deal of the suspended matter is thus removed from the tank effluent which reduces clogging and increases the life of the beds. It is Mr. Daniels' experience that the value of underfed beds is diminishing. If the effluent is very septic this method has the advantage of reducing odors, but as Mr. Daniels has pointed out, the practise of reducing the storage capacity of tanks is becoming prevalent.

In many plants the sewage is distributed by mechanical appliances, some being motor driven and others cable driven. Springfield, Missouri, which uses a motor drive, reports a saving in power, first cost, moving weight, and maintenance, over the cable drive. Another advantage is that the length of the filter can be increased at will. The

total cost of the distribution per million gallons according to Springfield's experience is $1.25 for cable drive and $1.61 for direct motor drive.

After the sewage has been distributed on the beds so that the interstices are filled, it is allowed to stand for a time. The bed is then drained and rested. While standing the sewage comes in contact with a jelly-like film which forms on the surface of the stone, and important changes occur. As with the septic tanks contact beds require a certain period in which to ripen. The time of contact and the period of rest vary in different plants. The rate of filtration varies according to the construction of the beds, the range is between 600,000 and 1,200,000 gallons per acre per day. The effluent from single contact beds is not stable but that from double contact beds is non-putrescible and low in suspended matter, although somewhat turbid. It can be discharged without offense into small streams. Single contact beds have seldom been used for final treatment of sewage and fewer filters of this kind are now being constructed even in conjunction with any preparatory treatment. The general opinion is that this process is on the wane. Watson says, "It may now be assumed that percolating filters are being constructed in England in preference to contact beds wherever the conditions are suitable." In America they are not being adopted for large installation but they are still considered for small disposal works. In their fifth report the Royal Sewage Commission of England states that taking into account the gradual loss of capacity of contact beds, a cubic yard of material arranged in the form of a percolating filter will generally treat satisfactorily nearly twice as much tank liquor as a cubic yard of material in a contact bed. Comparing the efficiency of contact beds and percolating filters it is claimed that the latter are better adapted to variations of flow and that the effluent is usually much better aerated; and apart from the suspended solids are of a more uniform character. With percolating filters

the likelihood of odors is greater than from contact beds and there may be a greater nuisance from flies.

In the report of the City of Leeds, England, the results of very valuable experiments are given. It says, "Double contact beds give good results with crude sewage and excellent results with partially settled sewage or with septic effluent. Single contact beds are insufficient for dealing with crude sewage but give fair results with settled sewage or with septic effluent. The real difficulty with contact beds is to maintain capacity."

The principal advantages of this process according to reports are low operating head, and less nuisance from odor and flies, and the disadvantages are large areas required and cost of maintenance.

Trickling, Percolating or Sprinkling Filters

Trickling or percolating filters consist of beds of coarse grained material such as pebbles or crushed stone, one-eighth to four inches in size, from four feet to ten feet deep and well underdrained. The character and strength of the sewage should determine the size of the material, the depth of the bed and the rate of operation. Some engineers give the capacity as about 20,000 persons per acre of stone surface; others say the rate of flow should be from one to two and one-half million gallons per acre. In some designs an auxiliary air supply is inducted into the filter material by tubes connected with the underground system. The Atlanta plant is equipped with ventilator hoods having weather vanes so that the mouth of each hood always points toward the wind. "This form of ventilation is of no particular value and may be detrimental in cold weather," says Glenn D. Holmes, Chief Engineer of the Syracuse, N. Y., Sewer Board. By means of spray jets and moving sprinklers operated with some device for varying the pressure, such as a butterfly valve, or by means of an intermittent dosing tank operated by a siphon, the sewage is sprinkled or deposited

on the surface of the bed in thin films and drops; thus the sewage is freed of objectionable gases and takes up oxygen as it passes through the air and through the filter. Sprinkling filters do not produce the best results when crude sewage is applied. They are most efficient when the suspended matter has been removed by some preparatory treatment. In some cities the screening process is first used, in others the sewage receives a preliminary treatment in tanks. Well designed and efficiently operated filters of this kind produce an effluent that is stable but not clear. Some plants are equipped with secondary settling tanks through which the effluent flows before final discharge and is freed of the humus-like particles it contains after leaving the filter. Reports agree that the effluent is not nearly so good in appearance and has a much higher percentage of bacteria than that produced by good intermittent sand filters. As compared with the double contact process the general opinion is that sprinkling filters are superior in respect to the removal of organic matter and cost less to operate. The chief advantages of a sprinkling filter are the high rate of filtration and the low cost of operation. The disadvantages are a possible nuisance, especially during hot weather, from odor when anything but fresh tank sewage is sprayed; and the development of insect life. Fowler says, "However economical their construction and maintenance it cannot be said that such a process meets all sanitary and æsthetic requirements." The experience of Worcester, Massachusetts, at its experimental station was that more than twenty times as much sewage per unit of area was treated by the sprinkler filter as could be treated by intermittent sand filtration, and more than ten times as much per cubic yard of filter. Four times as much sewage was treated by these experimental filters as could be treated satisfactorily by experimental contact beds. In order to obtain equal nitrification with contact beds at least three contacts would be required.

Intermittent Sand Filters

As a final process of purification in sections where land and filter material are available at small cost the intermittent sand filter is superior to any other. This fact has been established by experience and experiments. The filter material may be clean, coarse sand or any other porous soil. If a natural area is available the method of construction is very much simplified and economical. The top soil is removed and used in embankments between the beds. If the water tables are low the beds are not underdrained. In artificial beds the size of the sand is important. While fine sand will give a more brilliant effluent than a coarser material, the sewage has to be applied in small doses with long periods of rest. The rate of purification is higher in coarse sand filters and the effluent while containing more bacteria is non-putrescible. About twenty-four inches of sand should cover the underdrains of tile, placed about five feet apart, and surrounded by small-sized gravel.

In some beds the entire bottom above the underdrain is covered with about six inches of gravel. In others the bottom is ridged, the underdrains being placed at the bottom of the valleys which are then partially or wholly filled with gravel. Risers are constructed at the head of the underdrain and an intercepting drain completes the system. The beds vary in size and number according to the amount of sewage to be treated. The operation of the filter is very important. The sewage must be applied rapidly in rotation to each bed until the surface is covered with about three inches of the liquid. The bed is then slowly drained and allowed to rest. Overdosing and lack of aeration cause clogging. The surface must at all times be kept clean and loose. To maintain this condition it is sometimes necessary to break up the surface to a small depth or periodically to remove the deposit on the surface.

In cold climates the operation of the filters in winter is

difficult and the quality of the effluent somewhat impaired. Several methods have been adopted to prevent freezing. Some filter beds are ridged so that when dosed the sewage flows in gutters. The ice which forms at the top of the sewage remains suspended on the ridges, thus permitting succeeding doses to flow underneath the ice. In other plants the surface of the filter is scraped into small piles which form a support for the ice. It is claimed that by this method the cost of subsequent cleaning is less than when the beds are ridged.

The effluent in properly constructed and managed plants is clear and odorless. The bacterial purification is as high as ninety-nine per cent. The Massachusetts State Board of Health in one of its reports says, "When sewage filters slowly and intermittently through five feet of porous earth and sand, an effluent is obtained which is as free from organic matter, from ammonia and from nitrites as many a natural spring water."

The only drawback noted to this process is the cost of treatment in large quantities where land and filter material are not available. Francis E. Daniels says that under such conditions the cost is almost prohibitive. For many cities sufficient area cannot be obtained at any price, and as population increases the difficulty will become greater.

The New York State Board of Health in general will approve only of the following rates of operation for different types of filters where suitable provision for preliminary treatment is made: Intermittent sand filters, 100,000 gallons per acre per day; contact beds, 100,000 gallons per acre per day per foot of depth; sprinkling filters, 300,000 gallons per acre per day per foot of depth. These rates of operation are based on a sewage contribution of 100 gallons per capita daily and no variation from these rates of filtration is allowed for any other per capita contribution of sewage. The allowable effective depths of said filters will

in general range from three to five feet; contact beds from four to seven feet; sprinkling filters, from five to nine feet.

Broad Irrigation

Broad irrigation, or sewage farming, is the oldest process of sewage purification, but the constant increase in population has made it necessary for cities to adopt other methods because of the area of land necessary for such a plant. Two processes are used, surface irrigation and filtration, a greater area of land being required for the former. Sometimes the two are combined into one process. For filtration and irrigation the sewage is generally first subjected to sedimentation or screening and then flows on carefully prepared land on which crops are usually grown. The areas are underdrained and are equipped with distribution systems.

Local conditions determine the method of irrigation, the ridge and furrow system being most generally used. The efficiency of the process depends upon the quality of the soil and proper management. Among the factors which should enter into the selection of the site are the quality of the soil, composition of sewage, method of disposal, kind of crops to be planted, contours and slope of surface, nature of the sub-soil, sub-soil waters, transportation facilities, nature of streams, nature of adjacent property, and availability of water supply. The best lands consist of a fine layer of alluvium overlaying a sub-soil of gravel, chalk or other porous material. Various kinds of crops are grown on sewage farms and the revenues therefrom help to reduce the cost of operation. They also assist in the purification. The principal drawback are heavy transportation cost and a prejudice against sewage-grown produce. During the rainy season when the quantity of sewage requiring treatment is greatest, less sewage can be used for irrigation and the growing of crops of sewage farms. All evidence points to the fact that broad irrigation is on a steady decline, al-

though the efficiency of the treatment under favorable conditions is very high.

Disinfection

When the bacterial efficiency of an effluent from either preparatory or final treatment is low and the effluent is discharged into a body of water from which water supplies are derived or shell fish are taken, disinfection is often found necessary. The purpose is to destroy objectionable bacteria and disease germs. Hypo-chlorite of lime and liquid chlorine are the two chemicals most commonly used. The principal advantages of the liquid chlorine over the hypo-chlorite according to plant supervisors and operators, are less cost of operation and space required for both apparatus and storage of materials, no loss of strength, no lime sludge, and no mixing tanks required. The claim is also made that it can be better controlled. Chlorine, however, is more expensive than hypo-chlorite and the control apparatus usually costs more. There is general agreement among engineers, that except as an emergency measure or under the above stated conditions, disinfection is too expensive a process on account of the amount of chemical required. This varies with the amount, method and degree of previous treatment of the sewage and the degree of bacterial elimination desired. Tests at the Cleveland Testing Station indicated that from five to seven parts per million of available chlorine will effect a bacterial removal of from eighty-five to ninety per cent.

Activated Sludge Process

Sewage treatment by aeration in the presence of sludge is the latest development in sewage disposal, and the process is attracting a great deal of attention in America. Milwaukee has constructed a plant to treat two million gallons of sewage a day. Houston, Texas, is operating a plant to treat the sewage for 160,000 persons, and Escanaba, Michigan,

and Jersey City, N. J., have favored the process. Experiments are now being conducted in Milwaukee, Baltimore, Washington, Cleveland, Regina, Chicago, Lawrence, Mass., Brooklyn, New Haven, Conn., the University of Illinois and many other places. The efficiency and economy of the process as compared with others which have long been in use have not been completely established. The chief points in dispute are sludge disposal and cost, but the indications are that these questions will soon be satisfactorily answered.

The process consists of passing raw sewage through tanks from eight to twenty feet deep in which a certain amount of activated sludge is always present. To mix the sewage and the activated sludge air is forced into the bottom of the tank under low pressure of sufficient volume to keep the liquor violently disturbed. From this aerating tank the mixture passes to another or sedimentation tank where the sludge settles and from which the clear effluent passes over a weir to its final destination. In order to maintain the proper volume of activated sludge in the aerating tank a portion of the sludge is pumped back from the sedimentation tank. The balance of the sludge is pressed and used for fertilizer base. The Milwaukee experiments indicate that in order to produce a clear, non-putrescible effluent about four hours aeration is required, twenty per cent. of activated sludge maintained in the aerating tank, and about 1.75 cubic feet of free air supplied per gallon of sewage treated.

The effluent is clear, odorless and practically free from suspended matter. The sludge will begin to decompose after forty-eight hours and must be pressed and dried within that time. Chief Engineer, T. Chalkley Hatton, of the Milwaukee Sewerage Commission, estimates that the sludge can be reduced to a fertilizer basis for about $8.75 per dry ton, including overhead charges. Basing the value of the sludge produced upon a low price per unit, he finds that Milwaukee sludge is worth $12.50 per dry ton, which

represents a clear profit of $3.75 a ton. From ten to twelve million gallons can be treated upon one acre of ground, which is about one-fifth the area required for sedimentation tanks and sprinkling filters. The reasons for the adoption of this process by Milwaukee after experimentation by competent engineers for more than a year are given by Mr. Hatton in a recent address before New York State city officials as follows: "It produces a better effluent than any other known process of sewage treatment except land treatment or intermittent sand filtration; it can be built upon a comparatively small area; it produces no objectionable odors or flies; it produces a sludge of sufficient value to meet the cost of its reduction to a fertilizer and therefore relieves the city of the difficult, complicated and wasteful method of sludge disposal common to all other processes; it is subject to complete and satisfactory control throughout its operation; it is not materially influenced by climatic conditions; occupying a small area, its first cost is less than any other known process from which an equal character of effluent can be obtained; its operating cost is not prohibitive."

In a discussion before the Iowa Section of the American Waterworks Association Dr. Edward Bartow commended activated sludge for its value as a fertilizer. This has been proved, he said, by its chemical composition, by its reaction with various solids and by its effect on the growth of plants. Pot cultures and garden experiments have shown that the nitrogen is in a very available form.

E. E. Sands, City Engineer of Houston, Texas, bases this statement on results of experiments conducted for a year: "Our investigation has demonstrated that sewage can be disposed of anywhere that there is a vacant tract of land in the city without creating a nuisance and without any objectionable feature." The total estimated cost for treatment will be about $9.14 per million gallons when the plant is run at the rate of 18,900,000 gallons per day. He

estimates that the total cost for treatment by the Imhoff tanks and the sprinkling filters would be not less than $11 per million gallons.

After an extended investigation by their sanitary engineers, Armour & Company have concluded that the activated sludge method will satisfactorily purify the industrial wastes from their Packingtown factories. Assistant Superintendent, M. D. Harding, estimates that from data now available the cost per million gallons exclusive of depreciation, interest and repairs, will be $3.

When considering the applicability of this process to conditions in any city consideration should be given to the following points. The process requires competent supervision, which Mr. Hatton claims may be a blessing in disguise in view of the experiences of cities which, after having built disposal plants of various kinds, have left their operation to the kind mercies of Providence with disastrous results. This process also requires the expenditure for constant power. The cheaper the power the more adaptable the process is commercially; but if the unit is small and the power cost high, the operating cost may be too great. The sludge must be constantly treated to avoid nuisance. The process produces a high degree of purification. If the local conditions do not demand this the process might be too expensive in comparison with some other process which will produce a satisfactory effluent.

Other Processes

A few cities, including Oklahoma City and Santa Monica, Cal., have electrolysis treatment plants. The process consists in passing the sewage between a system of electrodes. The change is brought about by chemical reaction from newly formed chemical reagents produced by the decomposition of inorganic compounds already in solution. It is still regarded as an unestablished process.

Boston has within the last year been testing a new proc-

ess of sewage purification invented and patented by a Boston chemist. By the addition of an acid, an attempt is made to precipitate the bulk of suspended matter and to form a sludge which can be dried and degreased thereby producing a salable and greaseless fertilizer as well as recovering valuable grease. Experiments by E. S. Dorr gave results so full of promise that arrangements were made for a study of the process under the supervision of the Sanitary Research Laboratory of the Massachusetts Institute of Technology. Robert Spurr Weston gives the results of this study in a recent issue of the *American Journal of Public Health.* His conclusions are that "with facts at hand the process would be very satisfactory for Boston from a sanitary standpoint, and is more promising economically than any other known method." He includes in his comparison the activated sludge process. An experiment by Boston on a larger scale has been recommended.

Trade Wastes

Industrial trade wastes, such as those coming from canneries, breweries, woolen mills, laundries, dye and cleaning works, paper mills, iron foundries, gas works and packing establishments and others cause nuisances around disposal plants, and the problem of their proper disposal is more difficult of satisfactory solution than the treatment of domestic sewage. Some wastes can be treated with domestic sewage at the disposal works without any difficulty, others require special treatment before being allowed to enter the sewers and often it is desirable to keep certain wastes out of the main sewers and dispose of them independently. Each particular problem must be considered by itself with due regard both to conditions at the factory, the expense burden on the producer of the waste and to the body of water into which the effluent is to be discharged. There are instances where cities have reimbursed certain manufacturers for treating their wastes separately, and others where the

manufacturers have reimbursed the city for the additional treatment required.

Sludge Disposal and Value

Authorities are generally agreed that the sludge problem is the center of the entire sewage problem, because it causes more trouble and is the most expensive part of the treatment. The method of handling it is just as important as the treatment of the sewage.

Wet sludge can be pumped out on land or into shallow places or it can be sent to sea in ships and allowed to sink. If pumped on land it must be spread out in very thin layers. If discharged into trenches it is ploughed into the ground after it has dried. In either case a large area of land is necessary and odors cannot be eliminated. Only cities located on or near the seashore can send their sludge to sea, and then the cost of disposal is rather high.

Sludge can be dried by pressing, in centrifugal drying machines, by mixing with some dry matter or by discharging upon drying beds. The cost of pressing is high, depending upon the amount of lime added, the kind of sludge pressed, and the size of the works. George S. Webster states that the average cost in large cities is ten cents per ton of wet sludge. It is especially applicable to chemical precipitation works as it must first be treated with lime or coal powder. When dried in machines the liquid contains much organic matter and is objectionable. The simplest method is to discharge the sludge upon drying beds of porous material and underdrained. The time for drying depends upon sewage treatment. Imhoff tank sludge will dry in less than a week, septic tank sludge in two weeks or more, and sludge from plain sedimentation will require about two months in summer and almost five months in winter. Cleveland, in order to overcome weather conditions at its experimental plant, built a covered sludge bed, modeled after standard greenhouse construction. The report

from the Testing Station is that during summer the period of drying is approximately the same as or possibly a little longer than with open beds. Eliminating the three winter months, the station report says, it is possible to operate beds of this type so that one square foot of surface will dry 0.8 cubic feet of sludge per year. Francis E. Daniels suggests that sludge can be handled faster by drying a small portion at one time and removing it from the bed before the next portion is drained off.

Dry sludge can be used for fertilizer or for filling low lands or it can be incinerated. Its fertilizing value is disputed except when produced by the activated sludge method. The filling in method is economical. Authorities advise the consideration of incineration by cities which burn their garbage.

Dr. Imhoff's recommendations are the use of sludge for agricultural purposes and for filling in low land. "In both cases," he says, "the sludge must first be dried and this is best effected upon a drying bed after the sludge has been decomposed in an inoffensive, odorless manner, in a separate tank through which sewage does not flow."

Many unsuccessful efforts have been made to extract the valuable ingredients from sewage, but to date the experience has been that they have been more costly to recover than they are worth. Dr. McLean Wilson, Sanitary Inspector of the West Riding of Yorkshire Rivers Board, believes that the valuable ingredients of sewage will ultimately be recovered and used since many capable experimenters are at work on the problem. H. W. Clark, Chemist of the Massachusetts State Board of Health, is of the opinion that sludge has some value and that "it seems inevitable that as the processes of drying, pressing and fat separation are improved and as nitrogen advances in price sewage sludge will become of greater agricultural value than at present." Experiments have been made at the Philadelphia Sewage Testing Station by burning dry sludge and wet sludge mixed

with fine coal. The results were unsuccessful. Experiments have also been made at the Cleveland station where it was found that the sewage sludge contained about one-half as much nitrogen and one-third as much phosphates as does the garbage tankage.

Management and Supervision

No matter how well a sewage disposal plant is designed or constructed it will not do its work in a satisfactory manner and produce desired results unless it is efficiently managed. Every plant should be in charge of a man who has knowledge of sewage disposal principles, is thoroughly familiar with his plant and who can act intelligently in an emergency. The New Jersey State Sewerage Commission in one of its reports notes the tendency of local authorities to permit the deterioration of disposal plants usually through inattention. "It cannot be too strongly urged on those charged with these, as of other public works, that a competent man in charge is a primary necessity and that the plant should be kept continuously in the highest state of efficiency." The same condition is complained of by the California State Board of Health and other state organizations. In one of its bulletins the California State Board says that "some of the plants are operating very indifferently well and some very badly. The general situation shows plainly the need of expert advice to municipalities with respect to general methods and necessary efficiencies from some central authority."

D. C. Faber, Industrial Engineer of the Iowa State College, goes so far as to claim that practically all nuisances in connection with plants can be traced directly to failure to give them attention. He says that even where plants have been found too small increased care in many cases could be made to offset lack of capacity.

In several states, such as New York, Pennsylvania, New Jersey, Kansas, Ohio and Massachusetts, the State

Boards of Health have supervision over the designing of new plants and the operation of those established. The good results obtained as a result of this supervision are evidence that similar powers should be granted to all state boards of health.

With a plant designed to meet local conditions, properly constructed and efficiently managed, a city should have no difficulty in disposing of its sewage economically, in a sanitary manner and without creating a nuisance.

Table

SEWAGE DISPOSAL

Name of City	General Data					
	Population	General Description Plant	Annual Cost of Operation	Gallons Treated Annually	Average Number Gallons Treated Daily	Per cent. of City's Total Treated
Albany, N. Y....	110,000	Coarse screens, Imhoff tanks and pumping station.	.....	.....	.....	.....
Atlanta, Ga.....	200,000	Coarse screens, grit chambers, Imhoff tanks, sprinkling filters.	$1.93 per M.G.	.....	16,000,000	90%.
Akron, Ohio.....	150,000	Screens, grit chambers, Imhoff tanks, sludge beds, sprinkling filters.	.....	.....	.....	.....
Alliance, Ohio....	22,000	Cameron tanks. Contact and intermittent sand filters. Imhoff tanks and slag contact beds now under construction.	2,200 per M.G.	.....	3,000,000	100%.
Auburn, N. Y....	37,000	Two plants. Grit chambers, settling tanks, dosing tanks, contact beds.	8,500	.....	675,000	22%.
Brockton, Mass..	63,000	Revolving screens, sand beds and sprinkling filters.	12,000	768,000,000	2,106,000	100%.
Bloomington, Ill..	12,000	Septic tank, center settling basin, 3 contact beds arranged around center basin, nozzle spray upon filter beds surrounding contact beds.	.....	275,000,000	750,000	100%.
Bristol, Conn....	15,000	Sand filter beds.	5,000	.....	1,500,000	90%.
Columbus, Ohio..	220,000	Grit chamber, screens, pumps, Imhoff tanks, sprinkling filters, final settling basins.	.....	5,163,000,000	21,300,000	All for 242 days.
Canton, Ohio....	70,000	Imhoff tanks, contact beds, crushed slag and gravel filter with automatic syphon, sludge drying beds, sand and pea gravel filling. Half of bed covered with greenhouse construction. Final effluent into creek.	20,000	700,000,000	1,900,000	95%.
Danbury, Conn..	23,000	Irrigation and filtration.	7,500	.....	300,000	.....
Dallas, Texas....	120,000	Screens, grit chambers, Imhoff tanks and sludge beds.	.....	.....	10,000,000	All.
Fond du Lac, Wis.	20,000	Sewage collected in receiving well and pumped into Imhoff tanks.	3,200	.....	.....	.....
Fresno, Cal.....	40,000	Partial purification by settling and septic process, and disposal of effluent by irrigation of alfalfa.	1,000	1,825,000,000	5,000,000	All.
Gloversville, N. Y.	21,000	Primary and secondary settling tanks, screen chambers and dosing tanks, sprinkling filters, sludge drying beds and sand filters.	22,000	1,022,000,000	2,800,000	90%.
Houston, Texas..	140,000	Activated sludge method, reinforced concrete aeration tanks, settling tanks and re-aeration tanks. Continuous flow, power houses and blowers.	9.25 per M.G.	6,570,000,000	18,000,000	All.
Independence, Kas.	12,000	Cameron tanks and filter beds.	.....	.....	.....	.....
Lackawanna, N.Y.	17,500	.....	.....	788,400,000	.....	95%.
Milwaukee, Wis..	450,000	Trial plant operated since 1916. Now designing activated sludge plant to treat all sewage.	.....	.....	130,000,000	.....
Mt. Vernon, N. Y.	38,000	Settling tanks, single story septic type, constructed in five units. Sprinkling overhead Phelps nozzle, dosing tanks with automatic syphon.	17,675	750,000,000	2,000,000	75%.
New Britain, Conn.	55,000	Sand filtration.	12,000	.....	4,000,000	All.
Oswego, N. Y....	24,000	.....	.....	.....	.....	.....

II (a)

IN AMERICAN CITIES

Sewerage System		Sewage Pumping						
Kind of Sewerage System	Preliminary Treatment	What Percentage of Sewage is Pumped to Plant	Gallons Pumped Annually	Daily Capacity of Pumps	Kind and Number of Pumps	Annual Cost of Pumping Station		Number of Feet Sewage is Raised
						Total	Per Million Gals. Raised a Foot	
Mostly combined.	Coarse screens and grit chamber.	Large part.	.....	Three 10 M.G.D. each and three 15 M.G.D. each	Three var. speed 24 in. and three const. 24 in. electric power.	.....	....	.....
Combined.	Grate bars 1½ in. apart, and three grit chambers.	Some.	50,000,000	.....	Centrifugal electric power.	.....	....	.....
Separate and combined.	Screens and grit chambers.	.....	.....	.....	.....	.....	....	.....
Separate.	Grit chambers.	None.	.....	.....	.....	.....	....	.....
Separate with some surface water.	Two grit chambers.	None.	.....	.....	.....	.....	....	.....
Separate.	Revolving screen.	All.	.....	6,000,000	Two Knowlestriple expansion condensing steam power.	$30,000	.975	40.
Separate.	Settling basin with weirs.	None.	.....	.....	.....	.....	....	.....
Separate.	None.	None.	.....	.....	.....	.....	....	.....
Separate and combined.	One in. and one-half in. vertical bar screens mechanically operated. Grit chamber.	All once and 10% twice.	5,163,000,000	50,000,000	One 12 in. Worthington, one 20 in. Morris, two 18 in. and one 12 in. De Laval. Electric power.	$23,656	.16	21.6.
Separate.	Coarse screens and grit chambers.	None.	.....	.....	.....	.....	....	.....
Mostly separate.	Coarse screens and grit chambers.	None.	.....	.....	.....	.....	....	.....
Separate.	Coarse screens and grit chambers.	All.	.....	22,500,000	Two centrifugal steam power.	.....	....	42.
Separate with cistern overflow connected with sanitary.	Screens and grit chambers.	All.	1,000,000 a day.	60,000,000	Four centrifugal electric power.	.....	....	.....
Separate.	Chamber for trapping crude oil.	None.	.....	.....	.....	.....	....	.....
Separate.	Coarse screens.	None	.....	.....	.....	.....	....	.....
Separate.	Coarse screens and grit chambers for two-thirds of sewage.	105.2% some twice.	8,611,000,000	80,000,000	One air ejector six single centrifugal pumps. Electric power.	$23,500 est.	.136	.25.
Separate.	.....	None.	.....	.....	.....	.....	....	.....
Separate.	Grit chamber.	95%.	788,000,000	720,000	Centrifugal steam power.	9,000	....	18.
Separate with first wash from street.	Coarse screens and grit chamber.	33%.	42,000,000	60,000,000	Three centrifugal, 20 million each. Electric power.	.....	....	22.
Separate with much wet weather infiltration.	Coarse bar screens.	15%.	110,000,000	5,000,000	Two vertical centrifugal electric power.	.....	....	26 ft. including friction.
Separate.	None.	None.	.....	.....	.....	.....	....	.....
.....	....	None.	.....	.....	.....	.....	....	.....

Table II (a)

SEWAGE DISPOSAL IN

Name of City	General Data					
	Population	General Description Plant	Annual Cost of Operation $	Gallons Treated Annually	Average Number Gallons Treated Daily	Per cent. of City's Total Treated
Pasadena, Cal....	42,000	Imhoff and septic tanks, sludge bed and sewage farm.	.....	730,000,000	2,000,000	95%.
Providence, R. I..	249,616	Settling tanks; disinfection.	54,954	9,078,620,000	24,872,000	.....
Philadelphia, Pa..	1,800,000	Pennypack Creek sewage treated	.....	450,000,000	1,250,000	One-third of 1%.
Reading, Pa.....	110,000	.....	21,500	2,000,000,000	6,000,000	60%.
Rochester, N. Y..	248,465	Detritus tanks, fine screens, Imhoff tanks. Plan made for effluent to run power plant. Sludge drying beds.	.....	.....	55,000,000 dry weather flow, 173,-000,000 wet weather flow	All.
Schenectady, N.Y.	87,000	Imhoff tanks and sprinkling filters.	23,000	.....	72,000,000	70%.
Sumter, S. C.....	12,000	Sewage only partly treated. A settling chamber only. No filtering bed.	8,000	.....	.....	.....
Tallahassee, Fla..	6,000	Single contact system, 3 beds, coke and sand, filtration with automatic apparatus.	2,500	.....	100,000	.....
Woonsocket, R. I.	43,000	Screening basin and filters.	.....	.....	1,500,000	.....
Worcester, Mass..	170,000	Chemical precipitation, sand filters.	60,000 exclusive of depreciation and interest.	6,094,000,000	.....	All dry weather flow and first part of storm water.

(Continued)

AMERICAN CITIES (Continued)

Sewerage System		Sewage Pumping						
Kind of Sewerage System	Preliminary Treatment	What Percentage of Sewage is Pumped to Plant	Gallons Pumped Annually	Daily Capacity of Pumps	Kind and Number of Pumps	Annual Cost of Pumping Station		Number of Feet Sewage is Raised
						Total	Per Million Gals. Raised a Foot	
Separate with first wash from street.	None.	None.	.....	.....	.....	.....	....	.....
Combined.	.....	Yes.	.....	.....	.....	.....	....	.....
Combined first wash from street.	Coarse screens and grit chamber.	Yes.	450,000,000	4,000,000	One eight in. and one ten in. Worthington, vertical. By gas.	.....	....	41.
Separate.	Two grit chambers.	All.	.....	One 6 and the other 8 millions.	Two centrifugal electric power.	$14,500	....	39.
Combined.	Six detritus tanks and fine screens.	.....	.....	.....	.....	.....	....	.....
Separate and combined.	.....	40%.	40,000,000	15,000,000	Five direct connected motor vertical centrifugal.	$10,000	....	23.
Separate.	Two grit chambers 20 x 30 ft.	None.	.....	.....	.....	.....	....	.....
.....	Grit chamber.	No.	.....	.....	.....	.....	....	.....
Separate.	Coarse screens between screening basins and pump well.	100%.	.....	2,200 per min.	Centrifugal. By steam.	.....	....	20½
Separate and combined.	Grit chambers	2%.	.....	.....	Four centrifugal. Electric power.	5,509.35	....	.....

Table

SEWAGE DISPOSAL IN

Name of City	Industrial Wastes			Sludge Disposal	
	Establishments Which Empty Wastes Into City's Sewerage System	What Kinds Are Treated Before They are Emptied Into Sewerage System	Methods of Treatment Where Wastes are Purified Separately	How is Sludge Disposed of	Any Revenue from Disposal Plant
Albany, N. Y.	.....	.....	.....	.....	.....
Atlanta, Ga.	Steel mills, tin can works, gas works, coal and gas plants.	From gas works.	Plain sedimentation.	Filling and fertiliser.	None.
Akron, Ohio.	.....	.....	.....	Burned.	.....
Alliance ,Ohio	.....	.....	.....	Dried on beds and hauled to farmers.	None.
Auburn, N. Y.	None.	.....	.....	.....	.....
Brockton, Mass.	Shoe factory and tannery.	.....	.....	Fertiliser and fill	None.
Bloomington, Ill.	No.	.....	.....	.....	.....
Bristol, Conn.	.....	.....	.....	Plowed into land	.....
Columbus, Ohio.	Tanneries, breweries, starch works, wool cleaners, packing plants.	None.	.....	Dried on beds and spread on city farm.	None.
Canton, Ohio.	Various factories, including iron and steel; chief waste is rags.	None.	.....	Fertiliser.	.....
Danbury, Conn.	Hat factories.	None.	.....	Fertiliser.	$400.
Dallas, Tex.	Packing houses, laundries, dye works.	.....	.....	.....	.....
Fond du Lac, Wis.	Laundries, cleaning establishments.	None.	.....	Filling.	.....
Fresno, Cal.	Fruit canneries and packing houses.	None.	.....	.....	.....
Gloversville, N. Y.	Leather and canneries; 26% of total is trade waste.	All.	Settling tanks.	Fertiliser and fill	$300.
Houston, Tex.	.....	.....	.....	Pressed and dried	.....
Independence, Kas.	.....	.....	.....	.....	.....
Lackawanna, N. Y.	None.	.....	.....	.....	.....
Milwaukee, Wis.	Breweries, tanneries, soap works, laundries, hair works and packing houses.	None.	....	Pressed, dried and sold for fertiliser.	.....
Mt. Vernon, N. Y.	....	.....	.....	Fill.	None.
New Britain, Conn.	Pickling liquor.	.....	.....	Fill.	None.
Oswego, N. Y.	.....	.....	.....	.....	.....
*Pasadena, Cal.	Laundries.	.....	.....	Fertiliser.	None.
Providence, R. I.	Woolen mills, bleacheries, dye houses, jewelry factories.	.....	.....	Pressed and carried away on scows.	.....
Philadelphia, Pa.	No.	.....	.....	Fertiliser.	None.
Reading, Pa.	Soap and dye works, tanneries, paper mills, breweries, laundries, hat factories, electroplating works.	.....	.....	Fertiliser.	None.
Rochester, N. Y.	.....	.....	.....	.....	.....
Schenectady, N. Y.	Laundries, locomotive and electrical works.	.....	Oil skimmed off top of tanks.	Fill.	.....
Sumter, S. C.	None.	.....	.....	.....	None.
Tallahassee, Fla.	Chera Cola Works, and garages.	None.	All run into grit chamber before entering main.	.....	.....
Woonsocket, R. I.	.....	.....	.....	.....	.....
Worcester, Mass.	Carpet mills, tanneries and dye works.	None.	.....	Fill and fertiliser.	None.

II (c)

AMERICAN CITIES (Continued)

				Final Treatment				
Is Effluent Disinfected	Is there a Secondary Settling Tank	Per cent. of Suspended Matter Removed	Per cent. of Bacteria Removed	What Degree of Purity Required	Is Plant Operating Satisfactorily	If Not, Why?	Distance of Plant from Center of City	Any Odor at Plant
No.	.....	.....	.....	.....	.....	.....	Two miles.	.....
No.	No.	.....	.....	.....	Yes.	.....	4–7 miles.	Not sufficient to cause inconvenience.
.....	Yes.	.....	.....	.....	.....	.....	.....	.....
No.	No.	.....	.....	.....	No.	No technical supervision. Large quantities of roof water during storms.	1 mile.	Yes.
No.	No.	.....	.....	.....	Yes.	.....	5 miles.	.....
No.	From sprinkl'r.	61.2.	95.	As high as possible.	Not entirely.	Sand beds in operation 22 years and have reached capacity.	3 miles.	During damp weather
No.	.....	.....	.....	.....	Yes.	.....	1½ miles.	Not over 1,000 ft. under worst conditions.
.....	.....	.....	.....	.....	Yes.	.....	2 miles.	Not much.
No.	Yes.	25.	80–90.	Varies with stream and weather conditions.	Some parts satisfactory; others not.	Insufficient capacity.	5 miles.	Yes.
None.	No.	98.	.....	85.	Yes.	.....	8 miles.	Very little.
No.	No.	.....	.....	.....	Yes.	.....	2½ miles.	None from beds; sometimes when flow exceeds maximum it is turned into swamp, and during hot weather there is odor.
No.	.....	.....	.....	.....	.....	.....	3½ miles.	.....
.....	No.	.....	.....	.....	Yes.	.....	1 mile.	No.
.....	.....	.....	30.	No standard.	Yes.	.....	7 miles.	Yes.
No.	Yes.	.....	.....	.....	Yes.	.....	2 miles.	Some.
No.	Yes.	95–98.	95–99.	85–90.	.....	.....	2.5 miles.	None expected.
.....	.....	.....	.....	.....	.....	.....	.....	.....
No.	No.	.....	.....	90.	Yes.	.....	1 mile.	No.
No.	.....	95.	95.	95.	.....	.....	Centre of city.	No.
No.	No.	70.	80.	Non-putrescible.	Yes.	.....	1 mile.	A few days noticeable ¼ mile.
No.	.....	.....	.....	.....	No.	Voids almost completely clogged by pickling liquor.	3 miles.	.....
.....	.....	.....	.....	.....	.....	.....	¼ mile.	.....
No.	.....	.....	.....	.....	Imhoff satisfactory septic "as well as can be expected of any septic tank."	.....	5 miles.	.....
.....	Yes.	.....	Total bacterial 64%; B Coli 96.9.	.....	.....	.....	.....	.....
Liquid Chlorine.	Yes.	60.	100 acid formers.	Absence of acid forming bacteria.	Yes.	.....	12 miles.	.....
No.	Yes.	71.1 exclusive of solids removed by grits.	86.	State standard.	Yes.	.....	3 miles.	Some at times of cleaning.
Plans made for such.	.....	.....	.....	.....	.....	.....	.....	.....
No.	No.	40.	70.	.....	Fairly so.	.....	2½ miles.	At first, but not now.
No.	.....	Great portion.	.....	.....	No objection as it empties into swampy stream.	.....	1½ miles.	Slight as it empties at mouth of outfall.
No.	Yes.	.....	.....	.....	Yes.	.....	1 mile.	Only when cleaning grit chamber.
No.	No.	100.	97.	.....	Yes.	.....	1 mile.	No, except slight smell like dish water.
No.	No.	87.	.....	No standard.	Effluent from sand filter excellent; chemical precipitation poor.	.....	3 miles.	Very little.

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ASHES AND RUBBISH

ASHES AND RUBBISH

COST AND METHODS OF COLLECTION AND DISPOSAL IN AMERICAN CITIES—EQUIPMENT—REGULATIONS—BY-PRODUCTS

So many cities either collect ashes and rubbish together or the two are collected by the same department or under the same contract that any attempt to give the experience of American municipalities with the collection of each of these wastes would be of little value. The collection of both kinds of waste will, therefore, be discussed with the idea of presenting such information as will give any city, large or small, a basis for determining the feasibility of ash and rubbish collection by municipal employees or by contract, giving the various methods used in the larger American communities, so that the one best adapted to local conditions may be adopted, and the price a city should pay for the service.

Any city contemplating the collection of its refuse or wishing to determine the efficiency and economy of the service it is giving or receiving must consider:

(1) Type of Collection system:
   a. Combined collection of garbage, rubbish and ashes.
   b. Separate collection of each kind of refuse.
(2) Method of Collection:
   a. By whom done.
   b. Districting of city.
      Number and location of districts.
   c. Organization of collecting force.
   d. Kind of equipment.
      Receptacles.
      Vehicles.
      Incinerators.

Paper presses.
e. Location of receptacles.
f. Frequency of collection.
g. Time of removal.
(3) Enforcement of collection regulations.
(4) Disposal:
Dumping exclusively.
Incineration, wholly or in part.
(5) By-products:

Collection Systems

The systems of collection and disposal are so closely related that they must be considered together. There are two kinds of collection systems, the combined and the separate. The combined system may be further divided.

Many large cities collect garbage, rubbish and ashes separately. Garbage is then incinercated or disposed of by the reduction method. Ashes are used for fill and the rubbish is sorted either at the dumps or in utilization plants and the unsalable material either dumped or incinerated or both.

The separate system is profitable only in the larger cities where reduction plants can be operated at or near a profit, where an incineration plant can be centrally located in order to reduce the cost of haul or the heat can be used to produce power or where the reclaimable rubbish is sufficient to pay for rescuing it.

A system that can be used with nearly all methods of disposal is the separate collection of garbage and the combined collection of rubbish and ashes. This is the most popular system in America, for in many cities garbage is disposed of separately and rubbish is dumped. In many such cases, and especially where the ashes are used for fill, separation is required to allow the disposal of the ashes in places not suitable for mixed material.

In cities which have destructors for the incineration of garbage and rubbish and which use the ashes for fill, the

separate collection of ashes and the combined collection of garbage and rubbish is the best system. In some cases a part of the ashes is added to the garbage to aid combustion.

Where the combined collection of garbage, rubbish and ashes is used the city disposes of all these wastes either by dumping or by total incineration.

In a few places furnace ashes are collected separately and rubbish, garbage and stove ashes together. When this system is used the furnace ashes are used for fill and the other wastes are incinerated.

There is considerable difference of opinion as to which plan is desirable, but practically all agree that local conditions should contribute the chief factor in determining which system is the best for a city.

The method of disposal is another factor. Reports agree that if all wastes are collected together as a rule the cost of collection will be less than if each is collected separately.

John H. Gregory, sanitary expert, says that separate collection will be found in many instances to be less convenient at the house and more complicated and more expensive than the combined collection. He asserts that the combined collection will usually prove to be cleaner and to have fewer objectionable features, and with this system it should be easier to secure and to keep a better grade of employees. He points out that the mixing of garbage with rubbish and ashes will prevent in a large measure the blowing about of the latter, will lessen the dust nuisance, and indirectly may lessen the cost of street cleaning. The decomposition of garbage is far less noticeable and from the point of view of preventing a nuisance the receptacles and wagons will not require such frequent cleaning. He says, also, that the fly nuisance is reduced to a minimum and that there is less likelihood of odor should the refuse be stored up for final disposition. As but one type of wagon is required for collection Mr. Gregory believes that the system

is probably easier to adopt and easier to enforce, fewer regulations being required.

In a discussion of the advantages of the incineration method of disposal the *American Journal of Public Health* says that ashes may be used for incineration on account of the percentage of unburned coal which they usually contain. The percentage of unburned coal in ashes is between 19½ and 24½. Several experts call attention to the cost of incineration. Mr. Gregory believes that when refuse is incinerated it may be more expensive to burn all ashes with garbage and rubbish than simply to burn the garbage and rubbish. He points out that in some cities it may be found advantageous to adopt the combined system in certain districts and separate collections in others, depending upon local conditions.

Careful consideration should be given to the following reasons for and against keeping ashes and garbage separate: It is not necessary to collect ashes so frequently as it is garbage; different methods of disposal require separate handling; garbage with its moisture when mixed with ashes will not freeze in the can as readily in winter, thus facilitating collection. Some experts, however, assert it is more desirable to keep the wastes separate in order to use the ashes for fill and to sell the reclaimable rubbish. Many cities require the separation either of all wastes or of garbage. Of the fifty largest cities in the United States and all cities in New York State only thirteen do not require that each class of refuse be kept separate. One or two report that the plan had to be abandoned as it was found difficult to get the people, especially those living in the poorer districts, to comply with the rule of keeping the wastes separate. Other cities, which do require a separation, report that while it was found difficult at the beginning to enforce the regulation, persistent educational work and patience eventually brought their reward. Where all of the waste is dumped many cities prohibit the mixing of

paper or combustibles with ashes and rubbish. If this is not done the experience of many cities is that there are liable to be serious dump fires.

Methods of Collection

Some cities have ash and rubbish collection done by contract; in others the work is done by city employees; in a few both plans are used; and in many small communities the work is done by licensed collectors. The last Census Report shows that in eighty-five of the 158 cities for which statistics are given the collection is made either by contract or by the city, 72 per cent. being collected by the cities and 28 per cent. by contract.

Collection by private collectors is by no means confined to the small cities, as the following table indicates:

TABLE III.—*Ash Collection by Private Collectors*

Population	Name of City	How Much Does Collector Charge Householder?	Does He Furnish Can and if so, Does He Require Deposit	Type of Wagon Used	How are Ashes Disposed of?	Does City Own or Rent Dump
100,000	Duluth,* Minn.....	15¢ per can	No	Box	Dump	Own
17,000	Glens Falls,* N. Y...	10¢ per can	Furnishes can, no deposit	.....	Dump	Own
10,447	Johnstown, N. Y....	50–75¢ trip	No	.....	.....	.....
12,273	Little Falls, N. Y....	$1 a load	No	1 horse, box	Dump	Own
40,093	Elmira, N. Y.....	10¢ per can	Yes, $1 deposit	.....	Dump	Rent
13,000	Cortland, N. Y.....	$1 per load, 15¢ per can	No	Any wagon with tight box approved by sanitary inspector, canvas cover	Fill	Rent
110,000	Albany, N. Y.....	10 to 13¢	No	.....	Dump	Free
10,474	Oneonta, N. Y.....	.....	.....	.....	Dump	Own
165,000	New Haven, Conn...	15c per can	No	.....	Fill	.....
11,136	Fulton, N. Y.....	10–15–25¢ a can	No	.....	Dump	Own
8,317	Oneida, N. Y.....	75¢ to $1.	No	Any type	Dump	Own
23,368	Oswego, N. Y.....	10 to 15¢	No	.....	Dump and fill	Own and rent
131,000	Grand Rapids, Mich.	15¢ a week for residence, special for others	.....	.....	Dump	.....
10,711	Rensselaer, N. Y....	10 to 13¢	No	Covered	Fill and dump	Own
58,571	Portland, Me.....	10¢ barrel	No	Open cart	Fill and dump	Free and own

* City also collects.

John H. Gregory is of the opinion that, as a general rule, the best results may be expected from municipal ownership and operation of collection equipment. The Chicago City Waste Commission reports that where the householder hires a private scavenger to remove ashes and rubbish it usually

results in greater cost than when the work is systematically done by the city at public expense. If work is done by contract supervision at public expense is almost imperative when the best results are desired. Regulation must be strict and well enforced. The experiences of cities which have used all three methods are in favor of municipal collection.

The stringent contract regulating the collection of garbage and ashes by contract in West Orange, New Jersey, contains some suggestions. That part referring to the collection of ashes provides that the contractor must have an office in town with a telephone and a person in attendance from 9 a.m. until 4 p.m. If notified of the failure of any employee to remove ashes the same must be removed within two hours. Ashes must be kept separate from garbage and collected in a different vehicle. Ashes must be placed in covered wagons and "properly constructed so as to conceal the contents and to prevent scattering on public streets and highways. Rubbish, papers, tin cans, etc., shall be considered ashes." It further requires that wagons must not be overloaded, must be numbered and painted once a year and cleaned each day. The contractor must discharge employees guilty of neglect or insolence. The dumping ground must be kept clean, and papers, tin cans, etc., must be covered with three inches of dirt. "If the work is unsatisfactory the Council may by resolution terminate the contract and the surety company will be compelled to make good the damages the city shall suffer as a result of the breach of contract."

In some cities where the refuse is disposed of by incineration, the municipality does the collecting and delivers to a privately owned disposal plant.

Districting the City

The number and location of the districts into which a city is divided depends upon the size, topography and popu-

lation of the municipality. The layout should also be influenced somewhat by the kind of collection equipment used. Particular attention should be given to the various kinds of collection vehicles and especially to the desirability of employing motor or horse-drawn vehicles or a combination of both, before the city is districted. The location of the dumps or incinerators and the frequency of collection are also important factors. It is generally agreed that the division should be such as to shorten the length of haul as much as possible and to avoid steep grades with loaded wagons.

Organization of Collection Force

The organization of the force depends upon the kind of equipment, system of collection, districting of city, location of receptacles, frequency of removal and time of collection. The common system abroad where the can is placed at the curb, is to have one or two workmen accompany the wagon, one acting as driver, while the other empties the cans. Some authorities say this is the most economical way. The common method of operating in this country is to have the driver make the collection from the back yard. This is claimed by many to be uneconomical, as the whole collection work is retarded. In some cities the so-called gang system is used. Workmen go down each side of the street about one hour ahead of the wagon and roll the cans to the curb. The driver empties the cans and workmen following the wagon take the empty cans to the back yard. Many believe that this makes the best use of the more expensive part of the equipment. John H. Gregory points out that when possible one man should always have the same route in order that he may become acquainted with the district and households.

The organization of the collecting force must be elastic so that changes may be easily and quickly made on account of the seasons and weather conditions. More wagons and more men are employed in winter than in summer. It is

also found necessary to increase the collection force when traffic conditions are made difficult by a snow storm and other causes.

Type of Equipment

The essential features to be considered in connection with the design and installation of equipment are sanitation, freedom from nuisance and selection of proper apparatus for economical operation.

Very definite conclusions have been reached by experts and officials about the kind of ash can to be used. It is agreed that the size must be limited because of the difficulty of lifting heavy receptacles into the collecting wagon. Workman's compensation insurance for city employees has forced cities to give more attention to this part of the equipment than previously for the reason that many employees are injured by straining. It is also agreed that the receptacles must be of metal or lined with metal to prevent fire from hot ashes. All receptacles, if left at the curb, should be covered to prevent dust.

Some cities require householders to use regulation size cans. It is asserted that this plan facilitates the collection. The attached tables contain a description of the type and size of can used.

There has been much discussion about the best type of wagon for ash collection, and much experimenting has been done and is still commanding attention. It is agreed that special attention must be given to ease in loading and emptying, to provision against leakage, dust and unsightly appearance, to noise when loading and in motion, to durability and to cost of maintenance. As a considerable portion of the men employed in collecting suffer strains and rupture caused by lifting heavy cans, it is imperative that the wagon be as low as possible. Most of those now in use are five feet or more from the sidewalk to the top of the sides. If the bodies of these wagons hung low, as they do in some cities, and the capacity were made up in length,

there would be less strain on the men and time would be saved in dumping.

The capacity of the wagon is influenced by the length of haul and topography of the city. In its study of the collection and disposal of waste in Ohio cities the Ohio State Board of Health says it is the consensus of opinion that for best economic results the wagon capacity should be from three to four cubic yards for the combined collection of ashes and rubbish. The average weight of rubbish and ashes is from 800 to 1100 pounds per cubic yard, according to some reports. H. DeB. Parsons, a sanitary expert, says the average weight of ashes per cubic yard is 1350 pounds and rubbish 200 pounds. Generally the mixture in summer is 35 per cent. ashes and 65 per cent. rubbish; in winter 75 per cent. ashes and 25 per cent. rubbish.

Until recently practically all of New York City's ash carts carried approximately one ton. The point was made that with this type of vehicle there is a great loss of time in carrying the load to the dump and returning empty. William H. Edwards, former Commissioner of Street Cleaning, claimed that there would be a greater saving if five-ton vehicles drawn by three horses and operated by four men were used. Mr. Edwards said that a test had proved that six cartloads could be collected and dumped in just about twice the time it took for one cartload under the conditions existing then. The city is now experimenting with motor apparatus designed for dustless and odorless collection of all kinds of refuse.

In a few cities one type of wagon is used for ashes and another type for rubbish. One new type of wagon has the body swung low on running gear, with dumping edges three feet, six inches above the pavement, and is pivoted at one end to facilitate dumping. It holds nine cubic yards and is divided by cross partitions into compartments, one for ashes and the other for garbage. The relative capacity of the compartments can be varied. Some of the types used in

American cities are described in the accompanying tables.

Some American and German cities are using, and others are considering the purchase and use of, motor trucks for collection purposes. It is generally agreed that motor trucks are economical only where the haul is long. A discussion of the merits of motor vehicles as compared with horse drawn carts will be found in the chapter on garbage collection. In some cities where the haul to the loading stations is long, trucks with detachable bodies are used for garbage, ashes and rubbish. The bodies are lifted by derricks from the truck and placed either on the train or on the trolley cars. In a few other cities horse-drawn wagons are taken to a central point in a district and then as trailers are hauled by tractors to the dumping grounds. The best system to be adopted depends entirely upon local conditions.

Location of Receptacles

Where should the can be taken from by the collector and to what place returned? The answer is important for it is one of the chief factors in determining the cost of collection. The location seriously affects the speed of collection. In Milwaukee it was found in 1911 that the average collector could enter from fifty to one hundred houses in an eight-hour day, and that the time consumed in cleaning one house was slightly over three minutes. The Cleansing Superintendent of London reports that a one-horse van of four cubic yards capacity, hauling to a dump two miles away, under normal conditions could make from 240 to 260 calls and collections each ten hours. If the can is placed on the edge of the curb, he says, it is possible to make 500 collections a day.

Some cities require that the can be carried by the residents to the curb. Others collect from rear yard, cellar, areaway or alley. In cities which collect during the day and require the cans to be left at the curb serious objections are reported because the array of cans and rubbish

along the street on the day of collection makes the thoroughfare unsightly. To overcome this objection several plans have been carried out:

(1) To collect at night.

(2) To require that cans cannot remain on the street more than one hour after being emptied.

(3) To require collectors to go into basements and back yards and to return the cans to these places.

(4) To collect in rear alleys.

Experience has shown that it is very difficult to enforce a regulation by which cans should be taken from the curb by householders at any particular time after they have been emptied. In many homes the husband is the only person who does this kind of work. The can has to be taken in the morning to the curb. The empty, therefore, must remain in the street until noon and if the collection is not made until afternoon or the husband does not go home to his midday meal, it remains there until night. Many cities report that to eliminate the unsightliness of miscellaneous boxes, pails, cans and barrels which line the curb on collection day the citizens are willing to pay the extra cost of having the collectors take the cans from the basements or rear yards and return them to the same place. It has also been found that rear yard collection facilitates and somewhat reduces the cost of street cleaning.

It is generally agreed that the best plan is to collect from rear alleys, but these do not exist in many cities. In a few places which have alleys the officials say their experience has not been satisfactory; but in nearly every instance there has not been found to exist any cooperation between the collection force and the public, due to the failure of the officials to educate the people.

Time of Collection

Usually ashes and rubbish are collected during the working hours of the day, but often it is customary to col-

lect them in the early hours of the morning, especially in the business section.

Night collection has been satisfactory in some cities. A few having this system require cans to be placed at the curb the night before. These are collected early in the morning and the empty ones taken to the back yard. The principal objection to night collections is the noise of the wagons and the dropping of the empty metal cans.

William H. Edwards, former Commissioner of Street Cleaning in New York, gives the following advantages and disadvantages of day and night collection:

Unsightliness of cans in front of buildings much less evident at night.

Retention of cover on receptacle easier in day time. When covers are removed day work has its disadvantages by the spreading of the dust by the wind.

Interference with sidewalk and roadway traffic less at night.

When receptacle is placed in areaway it is more difficult for the collector to see at night whether or not there is material to remove.

Intense heat in summer is a drawback both to men and animals in the day collections.

Spilling of material is of less importance at night.

Night collection necessitates the extra charge of lighting the dump.

Supervision of night collection is considerably more difficult.

Night collection was tried in New York, but was abandoned after the strike in 1911.

Frequency of Collection

The number of collections that should be made in a given period depends upon the amount of ashes, the density of population, the season of the year, the climate and the degree of cleanliness desired. Most cities collect more fre-

quently in winter than in summer and some collect more often in the business districts than they do in residential and outlying districts.

Samuel A. Greeley, sanitary engineer, believes that ashes and rubbish should be collected at least twice monthly even in summer. Most cities do better than that, some collecting daily and many collecting more than once a week.

Enforcement of Collection Regulations

In cities in England and on the Continent, where the ashes, garbage and rubbish are collected together, collections are in general made three times a week; when collected separately, one collection a week is regarded as sufficient.

Detailed regulations should be made and distributed on cards among householders. They should include the kind of receptacle to be used, how the waste should be prepared to facilitate collection and where the cans should be placed. For example, Richmond, Virginia, provides by ordinance that the occupant of any house shall cause all ashes and other non-combustible refuse matter to be put in receptacles of not less than five or more than twenty-four gallons capacity. Ashes and other non-combustible matter is construed to mean ashes from coal and other fuel and such material substances as may collect in connection with the ordinary conduct of a houeshold, but not such as may result from building operations or repairs. Any person violating any of these provisions must pay a fine of not less than $1 or more than $20.

The enforcement of regulations is facilitated by and grows easier with the growth and development of the collection system and with the regularity of collection. It is always difficult at first. The rules and regulations, a description of the collection system and the aims of the collecting department should be printed on cards and hung in every household. Annual cleanup campaigns have been found useful by officials who desire to educate the public.

Disposal of Ashes and Rubbish

The following methods of disposal are used by cities:

(1) Dumping.

(2) Burning combustible rubbish that is not salable and using the ashes to fill in low land, or for road or sidewalk making, or selling part for use in partitions for fireproof buildings or for laying cellar floors.

(3) Incinerating with garbage.

When the dumping method is used cities either own their own dumps or secure the privilege for or without a fee for disposing of the waste upon land privately owned. In most cases the waste is used for fill and no fee is paid by the city. A few sea-coast cities dump their combined refuse at sea, but this practise is condemned. Where only ashes and rubbish are used the most common practise is to place the rubbish and light material near the bottom and to surface the dump to a depth of several feet with ashes. This makes a neat and finished appearance. Where ashes, rubbish and garbage are collected and dumped together, many cities have found that the so-called sanitary fill method, described in the chapter on garbage, is the most satisfactory. It is becoming more and more difficult for cities to maintain dumps on account of the congestion of population, which forces the municipality to seek disposal places far away from the centers, thus increasing the length of haul. If paper, garbage and combustibles are allowed on the dump, fires are apt to result and these make odors and smoke which are unpleasant and unhealthful. These fires are often very difficult to extinguish, especially if the dump is a deep one. Iron cages are sometimes used at the dump for burning the valueless combustible rubbish.

Some cities are successfully operating incinerating plants for the destruction of garbage and combustible rubbish; others have plants which burn the garbage and rubbish and a part of the ashes. Where ashes are burned they are

collected with the rubbish and garbage in those districts nearest to the incinerating plant in order to reduce the length of haul.

Revenue from By-Products

Many cities as yet make no effort to secure and dispose of the by-products, which consist of metal, rags, paper, tin cans, bottles, and ashes; in others the problem is being studied seriously. In comparatively few considerable revenue is derived. Generally junk dealers are allowed to overrun the dump and select what they want. A few cities charge for this privilege, the price being determined by bidding. The cities which derive the most revenue are those which do the sorting and selling themselves.

The St. Paul Sanitation Committee came to the conclusion that 33 per cent. of rubbish has value and that of this salable material 80 per cent. is paper, 10 per cent. rags, 5 per cent. tin cans, 3 per cent. bottles and 2 per cent. is miscellaneous. It says further: "The best authorities agree that in cities of 500,000 or over the recovery and utilization of wastes may result in some profit, but in cities of less population the amount recovered will not warrant the construction of expensive plants to make the separation and recovery." In the smaller places some revenue can usually be secured by letting out to junk dealers the privilege of picking over the dump.

It has been estimated that in New York City 48 per cent. of a ton of rubbish is worth $1.44 to the picking contractor and the remaining 52 per cent. is worth at least $1.25 when burned and transformed into electrical energy.

It has been suggested in one or two large cities that the unskilled and handicapped labor out of employment and seeking city aid be employed on dumps to pick out the unconsumed coal from the ashes screened automatically. Besides furnishing employment at any season of the year, it is claimed that coal in paying quantities could be secured

for municipal consumption. This claim is based on the reports of experts who have analyzed ashes and found the amount of unburned coal to run as high as 24½ per cent.

In Passaic, New Jersey, the papers, rags, etc., are picked out at the dump by junk dealers. In Cincinnati, Ohio, the revenue from salable rubbish has been over $2,000 a year. Evanston, Illinois, which dumps its ashes on the river front, was compelled to find some way of disposing of its waste paper so that it would not scatter through the neighborhood. A baling press was put into service and it is reported by the city that excellent results followed. The city collects and bales the paper in both business and residential districts. The paper is placed in gunny sacks and these are hung just inside the alley gate, or barn or stable on the morning of the designated day. It is said this system (1) takes a day's work each week from the routes of each of six men who collect rubbish on the east side of the city; (2) prevents the blowing of loose paper about the street and alley and in the neighborhood of the dump; (3) pays for the operation of the press and leaves a balance to aid the rest of the service. A man, employed eight hours a day, drives the wagon and presses the paper. Camden, New Jersey, which keeps its ashes separate, collects its rubbish and paper, and takes them to a sorting place. Prisoners in the city jail for minor offenses are kept busy sorting and baling the rags and paper. Nearly a million pounds of paper were baled and sold in one year. Cleveland in one year spent $230,000 for removal of its ashes and rubbish, and received $30,000 from the sale of the material sorted from its rubbish. The paper was sold for $5.60 a ton in bags at the plant of a boxboard company. Tin cans were sold for $5 a ton loaded on cars and delivered to a company making silk skirts. The metal, bottles, rags, etc., were sold to local dealers under competitive bidding. The rubbish not valuable was used for fill. The caretakers of dumps are expected to recover the salable portions of the rubbish. One

of the small New York cities gives the privilege of sorting the dump to a man who in payment therefor acts as caretaker of the dump. A few cities sell their ashes to contractors for cellar floors and partitions in fireproof building.

The high prices paid for reclaimable rubbish since the war began and the demand of the Federal Government that nothing be wasted have caused many cities to give much attention to the matter of rescuing salable rubbish.

Cleveland's specifications for picking the scrap materials from the various city dumps contain among other provisions the following:

"The successful bidder and his employees shall have free access to the dumps and shall have the exclusive right to gather and sell or remove the salable refuse, scrap and other waste material, except the soil, earth and ashes, for the period of one year; but nothing herein contained shall be construed to give the successful bidder the right to charge either the cities or other parties for dumping on such dumps.

"The Superintendent of the Division of Street Cleaning shall have complete supervision of the dumps and shall designate what material and refuse shall be deposited on the dumps and the manner and the places where such deposits shall be made; and should he deem it necessary shall have the right to place Street Cleaning Department employees on the dumps to supervise such dumping.

"The successful bidder shall shovel and level all refuse or materials and shall keep the dumps clean and free from nuisance of all kinds. He shall be responsible for all damages caused by the dumps and shall extinguish all fires which shall arise thereon.

"The successful bidder if he desires to store or pile upon the dumps any refuse, scrap or waste material, which he may gather shall pile or store it at places designated by the Superintendent of the Division of Street Cleaning or his employees and any material or stores so piled shall be re-

moved within ten days (10) after the expiration of the contract, and if not removed within that time shall be the property of the city.

"The City reserves the rights to use the dumps for any purpose whatsoever in such manner as not to interfere with the picking, gathering and carting away of waste material by the successful bidder.

"The contractor shall pay to the city on or before the 15th day of each month, the amount due for the use of the dumps during the previous months. On failure of the contractor to make payment to the city within the specified time, The Director of Public Service may declare the contract forfeited and refuse the contractor the further use of the dumps and may hold the contractor and his surety for the full amount due the city.

"In case the contract is forfeited the city reserves the right and the bidder agrees that the city shall have the right to let out in the open market or otherwise, the use of such dumps, and if the price thereon realized is less than that specified in the contract with the successful bidder, the difference in price, together with any additional expense incurred in arranging for the letting out to other parties, will be charged to the contractor and his surety.

"Should it become necessary for the city to abandon dumping on any or all of the dumps herein specified, the city shall notify the contractor in writing that dumping is to be discontinued on such dump or dumps, and in such case the contract covering such dump or dumps is to be terminated with the closing of the dumps, and the contractor shall pay the city for any fraction of the month which he may have picked from such dump or dumps.

"The city reserves the right to reject any or all bids or part of any bid."

The following specifications explain how Los Angeles, California, cares for its rubbish dumps and obtains a revenue:

"The service required by these specifications is to furnish facilities for disposing of the non-combustible rubbish collected from that portion of the city south of the summit of the Cahuenga Pass, north of Manchester Avenue, and east of a line parallel to and three hundred (300) feet distant westerly from Beechwood Avenue, in that portion of the city known as the Palms Annex, for a period of four years from April 20, 1917.

"The contractor shall maintain a dumping ground for the rubbish, which said dumping ground shall be accessible at all seasons of the year by one or more suitable graded and surfaced streets or roads. The location of the dumping ground must be such that in the opinion of the Board of Public Works it will not be unduly objectionable to the public.

"The unloading points within the grounds must be convenient of access for all vehicles used by the city for rubbish transportation.

"The rubbish will be brought to the dumping ground by the city, will be unloaded by the city at such readily accessible points as the contractor shall designate, and will, after unloading, become the property of the contractor.

"The contractor shall keep the dumping grounds in an orderly condition and shall so direct the dumping as to avoid congestion of vehicles or delay to same on the dump. He shall not use the dump for storing material in a manner which will interfere with the passage of the city's vehicles.

"In case accidents or conditions beyond the control of the contractor temporarily deprive him of the use of his facilities for disposing of the rubbish the city will, upon notification by the contractor of his inability to receive it, dispose of it elsewhere, and charge the contractor twenty-five (25) cents per load of ten cubic yards for the disposal of same.

"In case the contractor fails to pay the city for the disposal of such rubbish from the hereinabove described dis-

trict as the contractor is unable to receive the contract may be declared forfeited.

"Bidders shall name a price per month which they will pay for the privilege of having the entire output of non-combustible rubbish from the above described territory dumped on their ground."

Efficiency Tests and Suggestions

A simple and effective plan for keeping accurate records is a great help in checking up the efficiency of a collecting force. In fact, records are imperative if any attempt is made to operate economically, for the cost is influenced by the many and small details of the work. A systematic record of all complaints should be kept and the activity of each collector should be definitely checked up. Some suggest that complaints should be recorded in a loose leaf ledger and a slip handed to the driver of the particular district from which the complaint comes. As an offset to the citizens' complaints the ledger should have leaves adjoining giving the reports of the driver. By referring to the ledger the complaint clerk can explain to the citizen why he is not receiving service. Others suggest that records should be kept of the daily, weekly and monthly work of each collector so that work of the various collectors may be equalized. They also suggest that there be recorded for each district the number of loads collected, miles traveled and complaints made. Some suggest a card system with cross index as more convenient than a ledger.

The following scheme has been suggested to check up the amount of work done: W, number of collection wagons; V, capacity of one wagon in cubic feet; F, interval between collection in days; T, time required to collect from one house expressed as part of an hour; C, percentage of working time spent by collectors in the actual time of collecting as distinguished from hauling to and from the point of disposal; D, length of working day in hours; S, number of

trips to point of disposal per wagon per day; P, total population; N, average number of people per house; R, daily quantity of refuse per capita cubic foot; g, daily quantity of garbage per capita-cubic foot; d, daily quantity of rubbish per capita-cubic foot:

Equation No. 1

$$S = \frac{D \times C}{T} \times F \times N \times R \times \frac{1}{V}$$

Equation No. 2

$$W \times \frac{P \times R}{S \times V}$$

The person making this suggestion says it is frequently easy for a superintendent to determine how much time his collectors are spending unproductively in going to and from the dump. He should also be able, he says, to determine quite accurately the frequency of collection, total refuse, capacity of wagon and average number of trips per wagon per day. With this data he can estimate from Equation No. 1 the time required to collect from one house. If excessive he may find it advisable to secure better cooperation between the collector and the housewife.

Per Capita Production

Any attempt to estimate the local ash production of a community based on the experience of any other city will end in failure unless all peculiar conditions in both are known and compared. Some authorities say that the rubbish and ashes produced per capita is from 325 to 530 lbs. a year. The following table gives the figures for some large cities:

	Lbs. per Capita per Year	Lbs. per 1,000 Population per Day	Average Weight per Cubic Yard
New York.....	1,162	3,175	1,100
Boston.....	975	3,120	943
Washington.....	825	2,640	1,200
Cambridge.....	....	....	1,150
Rochester.....	....	....	900

Table

ASH AND RUBBISH COLLECTION

Name of City	Average Quantity Collected Daily		Annual Cost of Collection and Disposal	Number of Collections Weekly					
				Business		Residential		Outlying	
	Summer	Winter		Winter	Summer	Winter	Summer	Winter	Summer
Binghamton, N. Y.	21 yds.	44 yds.	$11,874.96	2	2	2	2	2	2
Brockton, Mass.	.....	.....	16,000.00	3	3	3	1	½	½
Cambridge, Mass.	.....	.....	85,000.00	1	1	1	1	1	1
Camden, N. J.	.....	.....	32,027.58	6	6	6	6	....	....
Cincinnati, Ohio	815 cu. yds.	935 cu. yds.	124,532.16	½	½	2	2	2	1
Cleveland, Ohio	.....	.....	209,920.85	0	0	½	½	½	½
Columbus, Ohio	.....	.....	65,763.31	6	6	½	½	½	½
Chicago, Ill.	3,515 cu. yds.	7,377 cu. yds.	1,077,786.91	E	E	2	F	1	F
Dayton, Ohio	280 cu. yds.	325 cu. yds.	28,494.29	1	1	½	½	½	½
Fall River, Mass.	.....	.....	38,889.76	1	1	1	1	1	1
Holyoke, Mass.	75B.	150B.	37,064.00	2	2	½	½	½	½
Hartford, Conn.	590 cu. yds.	840 cu. yds.	79,957.53	6	6	1	1	1	1
Kingston, N. Y.	.....	.....	9,000.00	1	1	1	1	1	1
Lynn, Mass.	.....	.....	25,833.27	1	1	1	1	1	1
Lowell, Mass.	.....	.....	21,277.51A	1	1	1	1	1	1
Los Angeles, Cal.	.....	.....	40,000.00	6	6	½	½	1	1
Milwaukee, Wis.	.....	.....	216,496.00	½	C	½	C	½	C
Newburgh, N. Y.	78 cu. yds.	168 cu. yds.	8,796.63	2	2	2	2	2	2
New Bedford, Mass.	.....	.....	47,000.00	1	1	1	1	....	....
New York City (Manhattan, Bronx, Brooklyn)	12,996.	18,558.	.....	6	6	6	6	3	3
Norfolk, Va.	.....	.....	13,929.75	6	6	6	6	6	6
Passaic, N. J.	82 tons.	120 tons.	22,000.00	6	6	2	2	1	1
Rome, N. Y.	45 cu. yds.	50 cu. yds.	.....	2	2	1	1	1	1
Syracuse, N. Y.	100 loads.	270 loads.	131,000.00	2	2	1	1	1	1
Somerville, Mass.	200 yds.	400 yds.	38,000.00	1	1	1	1	1	1
Schenectady, N. Y.	.....	.....	.....	6	6	1	1	1	1
Wilmington, Del.	150.	250.	38,411.77	1	1	1	1	1	1

ASH COLLECTION AND DISPOSAL

Boston, Mass.	587.	1,315.	$804,344.94G	3H	3H	2	2	1	0
Buffalo, N. Y.	425 tons.	775 tons.	.....	....	....	....	....	....	....
Chattanooga, Tenn.	.....	.....	.....	2	1	2	1	2	1
Duluth, Minn. (J)	30 cu. yds.	35 cu. yds.	.....	12K	12K	12K	12K	....	....
Glens Falls, N. Y. (J)	.....	.....	.....	....	....	....	....	....	....
Memphis, Tenn.	60.8.	70.7.	37,446.30	6	6	1	1	1	1
Niagara Falls, N. Y.	.....	92 cu. yds.	14,000.00	6	6	2	2	1	1
Peoria, Ill.	.....	.....	.....	....	....	....	....	....	....
Rochester, N. Y.	58 tons.	107 tons.	172,037.92	6	6	1	2	1	2
Spokane, Wash.	48 cu. yds.	190 cu. yds.	.....	6	6	2	2	2	2

IV (a)

AND DISPOSAL BY MUNICIPAL FORCES

Average Miles, Length of Haul	Cost, Collection and Disposal			From Where is Can Collected and Where Left	Size and Type of Can
	Cubic Yard	Per Capita Served	Per Ton		
1½	$0.1025	$0.66	$1.73	Curb.	Metal, covered, not less than 10 gals. or more than 28 gallons.
1	.25	.25	.....	Sidewalk.	Galvanized, 2½ cubic feet.
1¼	.39	1.00	.....	Yard and gate.	Not larger than flour barrel.
½	.3079	.....	.....	Front or rear of house.	All sizes.
.....	.488	.304	.....	Property line and gate.	Any size that can be handled by 2 men.
.....	.....	.....	.....	Taken from back yard, left at edge of sidewalk.	Any size that can be handled by 2 men.
2	.42	.229	.....	Alley, street entrance.	Not larger than man can carry.
6	.72	.427	.....	Alley and curb.	Galvanized, covered, 15 to 30 gals.
1½	.30	.19	.....	Alley and curb.	One that 2 men can handle easily.
.....	.347	.31	.....	Curb.	About size of flour barrel.
¾	.....	.61	.....	Yard or basement.	No. 2 Witt or can or barrel that size.
1	.3575	.615	.....	Yard.	No larger than flour barrel.
½	.....	.....	.....	.....	.....
½	.314	.....	.....	Curb.	None specified.
½	.18A	.19A	.....	Curb.	Not larger than flour barrel.
¾	.....	.....	.....	Curb.	Five to 30 gallon.
2–4	.65	.46	.....	Yard or basement.	One-half bushel metal basket for basement or metal lined box for yard.
4½	.....	.....	.....	Curb.	No standard.
1	.....	.....	.....	Curb.	No standard.
1					
¾	.9614	.8602	.....	Within stoop line.	Cans 3 cu. ft. galvanized cylindrical in form.
1	.325	.14	.695–6	Curb.	Ordinary ash can, bushel and a half.
2	.53	.31	.74	Curb.	All sizes.
¾	.90	.51	.....	Curb.	No standard.
2	.....	..80	.....	Yard.	Galvanized iron can.
2	.....	.....	.....	Sidewalk.	Not larger than flour barrel.
1	.....	.....	.....	Back yard and cellar.	Galvanized, from 1 to 3 bushels.
.....	.....	.86	.....	Curb.	Not exceeding 100 pounds.

BY MUNICIPAL FORCES

1	.70	.73	1.73	Back yard.	Galvanized, not larger than flour barrel.
1	.594	.45	1.50	Yard.	Galvanized ⅓ cu. yd. capacity.
.....	.....	.....	.....	Sidewalk and alley.	Covered.
1	.....	.....	.....	Back yard.	Twenty gallons is standard size.
2	.....	.....	.....	House.	Ordinary ash can.
2	.34	.25	.60	Convenient place.	No special size.
1	.92	.321	2.60	Yard.	All kinds.
.....	.....	.....	.....	Alley, yard, curb.	Fireproof receptacle of iron, brick or cement, must be covered.
2	.514	.688	.969	Curb in business section, rear in resident section.	No standard.
1½	.65	.....	.....	Basement or yard.	Fifteen to 30 gallon.

Table

ASH AND RUBBISH COLLECTION

Name of City	Average Quantity Collected per Year					Population Served per Man Employed
	Tons	Cubic Yards	Loads	Cubic Yards Per Man Employed	Cubic Yards per Capita Served	
Binghamton	5,783.8	9,643	4,824	570	.64	833
Brockton	.....	57,090	28,540	.....	.....	.....
Cambridge	.....	110,000	.....	1,506	1.	1,883 summer and 1,294 winter
Camden	.....	104,013	30,479	3,467	.....	.....
Cincinnati	.....	266,057	61,573	2,441	6.48	3,766
Cleveland	.....	356,337	.....	.....	.....	.....
Columbus	.....	155,812	36,663	3,116	.78	4,400
Chicago	.....	1,499,667	300,228	.....	.....	.....
Dayton	.....	93,915	18,783	3,757	.625	6,000
Fall River	.....	111,946	23,844	3,292	.89	4,025 in summer 3,372 in winter
Holyoke	.....	.....	.....	.....	.....	1,599
Hartford	.....	223,547	49,680	2,850	1.72	2,239
Kingston	.....	.....	.....	.....	.....	.....
Lynn	.....	80,000	160,000–180,000	3,750–3,333	.....	.....
Lowell	.....	114,059	30,827	3,168	1.05	3,999
Los Angeles	.....	3,900	.....	.....	.....	.....
Milwaukee	.....	333,375	111,125	555	.70	783
Newburgh	.....	40,376	.....	.....	.....	.....
New Bedford	40,275	.....	24,561	.....	.....	.....
New York City (Manhattan, Bronx, Brooklyn)	3,477,313	9,125,974	3,383,044½	.....	1.7759	.....
Norfolk	21,159	44,454	33,064	2,020	.46	4,318
New Orleans	.....	.....	.....	.....	.....	.....
Passaic	29,681	41,085	16,434	2,566	.68	.....
Rome	.....	15,000	10,000	1,500	.....	2,500
Syracuse	.....	.....	.....	.....	.....	.....
Somerville	.....	.....	.....	.....	.....	.....
Schenectady	.....	.....	.....	.....	.....	.....
Wilmington	.....	.....	.....	.....	.....	5,300 in summer 3,785 in winter

ASH COLLECTION

Boston§	324,313	795,862	238,361	.....	1.004	1,553
Buffalo	157,978	385,015	70,171	.....	1.	.....
Chattanooga	.....	.....	.....	.....	.....	.....
Duluth	.....	15,000	.....	.....	.....	.....
Glens Falls	.....	.....	.....	.....	.....	.....
Memphis	62,000	108,675	62,100	1,752.8	.73	2,403
Niagara Falls	5,180	14,800	4,050	.....	.33	3,460
Peoria	.....	.....	.....	.....	.....	.....
Rochester	177,555	334,852	83,713	1,913 7M	1.33	1,428
Spokane	.....	.....	.....	.....	.....	.....

IV (b)

BY MUNICIPAL FORCES (Continued)

Number of Men Employed Collection and Disposal		Number of Men Employed on Each Wagon	Type of Wagon Used	Number of Wagons Used		Motor Vehicles Used for Collection	Motor Vehicles Used for Short or Long Haul
Summer	Winter			Summer	Winter		
17	21	3	Troy chassis, Lee body.	3	5	1.	Long
17	17	3 to 2 carts	Two wheeled dump and 4 wheeled rubbish.	9	11	None.	.....
60	85	2–3	Shabolt, single and double.	Varies.	Varies.	None.	.....
30	30	1	Dump wagons and carts.	18	18	None.	.....
98	120	2	Two horse dump.	49	60	None.	.....
.....	.....	5–6	Dump and trucks.	.....	.....	47.	Long.
50	50	1	3–4–5 dump, special 16 yd. for rubbish.	45	45	.....	.....
240	420	1–2	Wood box hired by city at $7 per day.	380	675	None.	.....
22	28	3	Star wagon, dump.	10	12	None.	.....
31	37	3	Low gear, with sides head and tail board	9	11	None.	.....
28	43	4–5	Single, dump, high sides.	14	26	None.	.....
46	69	4	Special, bottom dump.	16	22	None.	.....
12	12	2	Box wagon.	4	6	None.	.....
24	24	2	Ordinary dump.	12	12	2 trucks.	Both.
36	36	2	Two-horse dump.	18	18	None.	.....
15	15	3	None.	.....	.....	7 trucks.	Both.
.....	600	3	Three yard wagon.	.....	200	3.	Long.
8	14	2	Dump.	3	6	None.	.....
34	40	2	End dump.	10	14	None.	.....
.....	.....	1–2–3–5	Single horse and 2-wheeled dump.	.....	.....	30.	Both.
22	22	1	Dump.	22	22	None.	.....
.....	.....	1	Two-wheeled dump.	183	183	None.	.....
14	18	2	Bottom dump.	7	9	None.	.....
10	10	2	Dump.	5	5	None.	.....
40	90	5	Dump.	20	45	None.	
45	65	3	Dump.	19	32	None.	.....
.....	.....	.....	.....	.....	.....	.....	.....
20	28	3	High sides, dump.	18	36	None.	.....

BY MUNICIPAL FORCES (Continued)

235	439	2–3	Sheet iron, single and double.	107	178	3 in summer, 8 in winter.	Long.
.....	.....	2	Dump.	.....	.....	None.	.....
22	22	1–2	.....	.....	.....	1.	.....
.....	.....	.....	10x3½ box, bottom lined with sheet iron.	2	2	None.	.....
.....	.....	.....	.....	.....	.....	.....	.....
62	62	1	2-wheeled cart.	62	62	1.	Short.
.....	13	1	Dump.	.....	45	None.	.....
.....	.....	1	Iron body, covered.	.....	.....	None.	.....
115	235	2–3	Bottom dump.	38	84	None.	.....
35	11	2	Bottom dump.	7	7	Five.	Long.

Table

ASH AND RUBBISH COLLECTION

Name of City	Description of Collection System
Binghamton	3 districts. Driver's route approximately 14½ miles long. One 5 ton truck, 14 and 8 trailers. Trailers divided into 2 compartments, containing 2 yards of ashes and one yard of garbage. When wagon is loaded team is hitched to empty trailer which has been left by truck.
Brockton	6 districts.
Cambridge	6 routes, 1 each working day, not evenly distributed. Six or eight men ahead of team roll barrels out of yard and teamsters place them back at gate when empty.
Camden	3 districts, each receiving 2 collections a week.
Cincinnati	Divided into districts and those subdivided into beats which are covered the same day each week. Two men (driver and helper) assigned to each beat.
Cleveland	.....
Columbus	22 districts. Each covered by 2 wagons. Men work together where it is necessary to handle heavy material.
Chicago	Wards divided into sections. Number of teams depends on size of section and service required. Ward in charge of ward superintendent. Districts in charge of section foreman. Section foreman and laborers uniform.
Dayton	5 districts with ground foreman at head of each. Each covered in 12 working days.
Fall River	.....
Holyoke	3 gangs work in business and one in residential sections all the time.
Hartford	2 sections, each divided into 6 routes. Each route extends into that portion of the central part of the city within the corresponding district. One main squad to each district covering one route daily. A section of each squad takes the barrel to the curb on hand trucks. These are followed by teams and two lifters who in turn are followed by a man who returns empty receptacles.
Kingston	Rigs and men assigned to certain districts of each section.
Lynn	Divided by wards. Men clean one section and move to another.
Lowell	6 districts, one cleaned each day.
Los Angeles	.....
Milwaukee	26 wards. Ash collection all year. Once every month to householders by wards. A gang comprises two teams and three men as collection is made from basements. This keeps men going while teams are on way to and from dump.
Newburgh	Divided into three parts. By understanding between men, each takes a certain street each time all are on certain routes.
New Bedford	Collection made quickly from every street. No districts.
New York	Boroughs divided into districts, 13 in Manhattan, 2 in Bronx, and 8 in Brooklyn. Each under control of district superintendent. Districts divided into sections, 103 in the aggregate and each in charge of foreman.
Norfolk	22 districts with one man and one wagon in each.
New Orleans	.....
Passaic	Two drivers and 2 lifters in each gang. One wagon loaded while other is on way to dump. District cleaned on certain day each week.
Rome	Divided into 5 districts.
Syracuse	.....
Somerville	City divided into 6 districts, one for each working day. Two lifters to each team.
Schenectady	5 districts.
Wilmington	4 districts. Driver and two lifters for each wagon.

ASH COLLECTION BY

Boston	10 districts with a foreman and inspection service in each.
Buffalo	16 districts with foreman in each. Number of men and wagons in each varies according to conditions.
Chattanooga	.....
Duluth	.....
Glens Falls	City removes all ashes that are clean and suitable for street work.
Memphis	3 districts subdivided into routes, man and cart for each route.
Niagara Falls	4 districts.
Rochester	10 districts with one or two gangs to district. Gangs organized into truckers, who haul ashes from rear of house to curb; lifters, who load wagon; and returners, who replace empty receptacles. Teams apportioned according to length of haul, so that empty wagon is ready to take place of loaded one.
Peoria	16 districts. Routes changed as demand increases or decreases.
Spokane	Ashes collected in business district by load, in residential district by can. One 3 ton truck collects ashes and garbage in residential district.

A Cost of labor. *B* Ashes and rubbish collected separately in business section. *C* Collected only when requested. *E* Trade wastes not collected by city. *F* Depends on quantity and condition. (*J*) Part collected by city and part by

IV (c)

BY MUNICIPAL FORCES (Continued)

Method of Disposal	Does City Own or Rent Dumps	How Much Revenue Does City Receive	Size of Load
Filling and covering garbage.	Own.	None.	2 yards.
Dump.	Free.	None.	2 cu. yds.
Dump.	1 rented, others free.	None.	.....
Fill.	Own and free.	None.	.....
Dump.	Free.	None.	4.3 yds.
Dump.	Own.	None.	.....
Dump.	Both.	None.	3–4–5 yds.
Dump and fill.	Own and free.	None.	5 cu. yds.
Dump.	Free.	None.	5 cu. yds.
Fill.	.....	None.	4.94 and 1.71 cu.yds.
Dump.	Own.	None.	1½ and 2 cu. yds.
Fill.	Free.	None.	4–5 cu. yds.
Dump.	Free.	None.	.....
Dump.	Own.	Very little.	2 cu. yds.
Fill.	Free.	None.	3.7 cu. yds.
Dump.	Rent.	None.	.....
Dump.	Free.	None.	3 yds.
Dump and fill.	No.	None.	2¾ yds.
Dump and fill.	Own some.	City once collected and baled paper but could not make it pay.	.....
Dump.	Own 27, others provided by contractor.	None.	.....
Dump.	Free.	None.	1½ cu. yds.
Dump.	Own.	None.	1½ cu. yds.
Dump.	Own.	$500 for privilege of placing over dump.	2½ yds.
Dump.	No.	None.	1½ yds.
Dump.	No.	None.	3 yds.
Fill.	Rent and free.	None.	.....
Dump.	Free.	None.	.....
Dump and fill.	Free.	None.	.....

MUNICIPAL FORCES (Continued)

Dump.	Rent.	None.	2½ and 4 cu. yds.
Dump.	Free but city pays for upkeep.	None.	5½ cu. yds.
Dump.	Free.	.....	.....
Dump.	Own.	None.	.....
Fill.	Own.	Improved streets.	.....
Dump.	Free.	None.	1¾ cu. yds.
Fill.	Free.	None.	Wagon 2½ cu. yds. truck 6 yds.
Dump.	Rent and free.	None.	.....
Dump.	Free.	None.	.....
Dump.	Own and free.	None.	3½ cu. yds.

private collector. *K* City has 2 teams which take care of central part twice daily all year. *§* Suburbs collected by contract. *G* Includes cost of collecting rubbish. *H* Daily hotels and restaurant. *M* Per man per day.

Table

COLLECTION AND

	Ashes and Rubbish		
	Indianapolis, Ind.	Mechanicville, N. Y.	Cohoes, N. Y.
Number of collections each week—			
Business Section—			
Winter	1 *A*	2	2
Summer	½ *A*	2	2
Residential Section—			
Winter	1	2	1
Summer	½	2	1
Outlying Section—			
Winter	1	0	1
Summer	½	0	1
Miles, length of haul	6	1	1½
Cost of collection and disposal per cubic yard	.....	.....	.....
Per capita served	.....	.....	.....
Per ton	.....	.....	.....
Where is can collected from and where left	Rear.	Curb.	Curb.
Size and type of can	Covered barrel.	Not larger than flour barrel.	Not specified.
Quantity collected in year—			
Tons	96,552	.....	.....
Cubic yards	64,368	.....	.....
Loads	32,184	.....	.....
Size of load	3 ton.	.....	.....
Cubic yards per man employed	201	.....	.....
Cubic yards per capita served	.214	.....	.....
Population served per man employed	938	.....	.....
Number of men employed—			
Summer	24	2	.....
Winter	50	2	.....
Number of men on each wagon	2	2	2
Type of wagon used	Steel King.	Covered.	Covered, Dump.
Number of wagons—			
Summer	12	1	5
Winter	37	1	5
Number of motor vehicles	.....	.....	.....
Motor vehicles used for short or long haul	.....	.....	.....
Description of collection system	.....	3 districts.	.....
Disposal of Ashes	Dump.	.....	.....
City own or rent dumps	River bottom.	Free.	Free.
Annual cost to city for collection and disposal	.....	$2,700	$3,900
Average quantity collected daily—			
Summer	10 tons.	.....	.....
Winter	10 tons.	.....	.....

A Not collected from public buildings or from steam, hot water or power plants, except in private residences or department houses of not more than 4 apartments each. *B* No collection made from stores,

V

DISPOSAL BY CONTRACT

Ashes and Rubbish	Ashes Only	
Philadelphia, Pa.	Washington, D. C.	North Tonawanda, N. Y.
1	2 B	1 C
1	1 B	1 C
1	2	1
1	1	1
1	1	1
1	1	1
1–2	1.64	1½
.37	.51	....
.39	.109	.15
.95	.85	.11
Curb.	Rear alley or areaway.	Curb.
Can't weigh with contents over 150 lbs.	Metal covered, 5 to 24 gals.	Metal.
676,200	91,070	.....
1,229,456	151,783	.....
.....	37,946	.....
.....	4 cubic yds.	.....
.....	12 in winter, 6 in summer.	.....
.67	.43	.....
.....	Varies.	4,343
.....	12	1
.....	120	3
.....	2-3	2
Wooden body, metal covered. Metal body, metal covered. Trucks, metal and canvas covered.	Bottom dump, canvas covered.	Dump.
.....	8	1
.....	60	2
31	4	.....
Both.	Both.	.....
City divided into 9 districts. Each district divided into 12 sub-districts; from each of these districts each day ashes and rubbish collected. Ashes placed at curb line and rubbish kept inside premises in readily accessible place. Rubbish card hung at gate and gives evidence that there is rubbish to be collected. Rubbish must be bagged or bundled. Ashes collected in amount not exceeding 400 lbs. from all buildings with certain exceptions. Rubbish collection in unlimited amount from residences and not exceeding 4 barrels from retail business houses. City has experienced difficulty in having ashes and rubbish placed separately in proper container. Unsuccessful attempt was made to facilitate this by having ashes and rubbish collected on separate days. In 1918 both will be collected on the same day.	Layout depends upon density and amount to be removed. Large part of city set aside to receive service on certain days. This is subdivided and definite routes assigned each wagon. Both city and contractor maintain inspection forces.	6 districts are arranged according to quantity of ashes collected as ascertained on trial collection of 3 months.
Fill.	Dump.	Fill.
Mostly privately owned.	Some owned.	Free.
$710,240	.....	$2,000
1,565 D	.....	2½ tons.
6,524 D	.....	15 tons.

hotels, etc. *C* Not more than 10 bushels collected from any one place in a week. *D* Collected by 9 contractors, one for each district. Steam ashes collected by private collectors.

Eleven cities report that the number of cubic yards of ashes and rubbish collected a year per capita served was from .46 to 1.72, the average being .89. Four other cities report that the number of cubic yards of ashes only collected a year per capita served was 1.016. The lowest was .73 and the highest 1.33.

Cost Data

An effort to compare the unit cost of collection and disposal in one city with that in another will prove to be most unsatisfactory for the reason that local conditions make necessary different methods, length of haul and systems, and these affect the cost of operation. Also, there are very few cities which keep any accurate and detailed cost data.

Reports from thirteen cities which collect ashes and rubbish by municipal forces show that the average cost of collection and disposal for 1916 was $0.4018 per cubic yard, the highest being $.72, and the lowest $.1025. Five other cities report that the average cost of collecting and disposing of ashes only was $.5596 per cubic yard.

The cost depends upon the cost of loading and the cost of haul.

GARBAGE COLLECTION AND DISPOSAL

GARBAGE COLLECTION AND DISPOSAL

SYSTEMS AND PRACTICES IN AMERICAN CITIES—FACTORS WHICH AFFECT THE COST—OPINIONS OF EXPERTS—COST DATA

LOCAL conditions are so variable that the problem of collecting and disposing of garbage is one of the most complex with which city officials have to deal. The results obtained by one city cannot in detail be applied to another city, although there are many characteristics common to all. Each city must study its conditions and then apply general principles with such modifications as its peculiarities make necessary.

The garbage problem divides itself into two natural divisions:

1. Collection, including house treatment and haul.
2. Final disposal.

The two are so closely related that the cost of different systems should be compared on the basis of combined cost of collection and final disposal. These two divisions may be subdivided as follows:

1. COLLECTION SYSTEMS.
    1. Type:
        (a) Combined (garbage, rubbish and ashes).
        (b) Separate (each kind of refuse).
    2. Method:
        (a) By scavengers.
        (b) By contract.
        (c) By city.
    3. Organization:
        (a) Districts.
        (b) Force.

4. Kind of Equipment:
   (a) Receptacles.
   (b) Vehicles.
   (c) Loading stations.
5. Location of receptacles.
6. Frequency of collection.
7. Time of removal.
8. Enforcement of regulations.

2. DISPOSAL.
   1. Method:
      (a) Dumping on land, for fill or at sea.
      (b) Plowing under.
      (c) Feeding to swine.
      (d) Incineration.
      (e) Reduction.
   2. By-Products.

3. METHODS OF FINANCING COST.

Types of Collection Systems

There are two types of garbage collection systems—the separate and the combined. Before deciding which is the better adapted to local conditions the method of disposal of all municipal waste—rubbish, ashes, dead animals, street sweepings and stable manure—must be considered. A further study should be made of the five combinations which have been adopted by American cities and which are outlined in the chapter on ash and rubbish collection. When garbage is collected separately, the method of disposing of it is by the reduction process, incineration or feeding to hogs. If it is collected with rubbish the two wastes must be incinerated. If ashes, rubbish and garbage are collected together the wastes are either dumped or incinerated.

As with ashes, reports generally agree, that if all wastes are collected together as a rule the cost of collection will be less than if each is collected separately. The method of

final disposal, the net cost of that method after deducting revenues, and the length of haul should be considered and carefully determined before any system of collection is adopted. The same arguments presented in the chapter about ash collection for and against the combined and separate methods of gathering ashes apply with equal force to the collection of garbage.

Robert H. Wylde, sanitary expert, advocates the mixed collection. He says: "There can be no doubt that the mixed collection is preferable from practically every point of view and possesses such great advantages that it is doubtful if it is ever compensated for (from the citizen's point of view) by economies realized from any method of disposal requiring separate collection." He also points out that for a separate collection, a city must have three distinct styles of carts, collections should be made in the early morning or during the night, and each house should be visited daily or at least every other day. Householders must be required to keep the materials in three separate receptacles; three calls must be made at each house and the same ground must be covered by three different classes of collector.

The Chicago City Waste Report, by I. S. Osborn and J. T. Fetherston, says that combined collection requires more frequent collection of ashes and rubbish than if garbage were collected separately. If separate collection of garbage is made a more frequent collection of garbage and a less frequent collection of rubbish and ashes can be made. If all wastes are collected together, it says, as a rule the unit cost for collection will be less than if collected separately.

In smaller communities, says Samuel A. Greeley, sanitary expert, it does not seem advisable to place all classes of refuse in one receptacle as ashes can be easily disposed of. By separating the garbage the bulk to be removed is smaller, the disposal by burial requires less land, much of the garbage can be sent to the farms for feeding, and the general cost of refuse disposal is reduced without seriously

lowering the efficiency. In cities of from 30,000 to 50,000, he asserts, the mixed system requiring only one can at a house and permitting incineration without the use of additional fuel, has many advantages. In such small communities, he believes, garbage does not have the advantages for reduction purposes that it has for the larger cities.

Methods of Collection

There are three methods of collecting garbage:

(1) *License System,* by which the city licenses certain cartmen, the individuals paying the expenses, usually under regulation of the Board of Health.

(2) *Contract System,* which provides that city pay a fixed amount annually for service, that certain schedule be paid by householder, or that contractor pay a certain amount to the city for privilege of collecting, and charging the householder for the service.

(3) *Municipal System,* by which the city does work with own or hired teams. In some cities, city employees collect a part and scavengers or collectors, or both, collect the remainder.

Experts are generally agreed that the best of the three systems is the last. They say that there is always much trouble when the contractor is allowed to collect pay from citizens served, and that to sanitary officers must be given full authority to fine those who fail to have garbage removed. Contractors' wagons also must be under the close supervision of sanitary officers.

The Chicago Waste Commission's report says that efficient service can be obtained by contract when the work is specified and the requirements are such as to obligate the contractor to furnish the desired service. The contractor, it asserts, must maintain an effective organization, sufficiently equipped and managed to be able to render proper service. Under this method, it points out, a rigid inspection is necessary on the part of the city and full compliance on

the part of the contractor in carrying out his agreement. The report also says that efficient service can be obtained by a municipal collection when the city conducts the work with its own teams and equipment and the men employed on the work are directly responsible to their superiors who in turn are responsible to the public for the service rendered. It gives the following advantages of this method:

(a) The service is rendered as desired. It is not necessary to specify how and what work is to be done, but the work can be conducted so as to meet conditions as they may arise.

(b) The work comes directly under the control of the officials whose chief object is to render satisfactory service at a reasonable cost.

(c) Better equipment can be provided and the work planned on a more systematic basis when investments are permanent.

(d) Municipal operation eliminates the tendency on the part of the contractors (when the work is done by contract) to obtain the largest remuneration possible at the least cost.

It is impossible, says the report, to develop efficient organization or to render the best service in collection with hired teams where the driver receives his pay from the employer, who in turn receives his pay fom the city for furnishing the team and driver.

In the majority of cities in the United States, the collection is done by the city, which owns its equipment and conducts the work under the supervision of its officials. It has been the experience of these cities that the results of municipal operation have, in most cases, proven satisfactory.

John H. Gregory, sanitary expert, believes that as a general rule the best results may be expected from municipal ownership and operation of collection equipment. A similar opinion is expressed in the report of the Special

Commission on the Collection of Municipal Waste, Worcester, Massachusetts.

Grand Rapids, Michigan, reports that under the municipal system, the cost per householder is $1.63 a year, while under the private contract system the cost was $3.00 a year.

Whatever system and method are selected to make it successful a city must (1) provide sufficient appropriation; (2) secure or insist upon an efficient organization; (3) have or require sanitary and economical methods of work, and (4) secure and foster cooperation on the part of the public.

House Treatment

Many cities require that garbage be drained and some that it be wrapped in paper as well as drained. Wrapping aids combustion when the disposal is by incineration. Wheeling, West Virginia, claims that wrapping garbage eliminates smell, preserves can, provides fuel and makes work much less unpleasant for the collector. Dr. P. M. Hall and Samuel A. Greeley advocate wrapping if garbage is burned. Seven cities, of those from which statistics have been received, require that garbage be wrapped—Dunkirk, Jamestown, Mount Vernon, Trenton, Milwaukee, Grand Rapids and Minneapolis.

Organization

It is agreed that the number and location of districts into which a city is divided must depend upon the size, topography and population, the location of sub-stations or the place of final disposal, the frequency of collection and the hauling equipment. It is also agreed that the divisions should be made with the purpose of shortening the haul as much as possible and to avoid steep grades with loaded wagons. Some cities haul direct from the district to the place of disposal, others establish loading stations or bunkers to which the garbage is hauled in wagons and from which it is taken for disposal in automobiles, train or trolley. Still

others have loaded wagons taken to a central place and from there hauled by tractors to the place of disposal.

The type of equipment, system of collection, organization of city, location of receptacles, frequency of collection and hours of removal must be considered when organizing the force. These vitally affect the cost. Some cities require one man to act as driver and collector. This system is regarded as uneconomical as the whole collection is retarded. Other cities have two men with a wagon, one to drive and the other to collect. In some cities the gang system, described in the chapter on ash collection, is used.

The Chicago Waste Commission makes these recommendations to insure an effective organization:

1. Individual responsibility for work assigned.

2. Employees should be paid for work performed instead of for hours of labor.

3. Published records of employees individually by sections under foremen and by districts under inspectors or superintendents will create a healthy rivalry and conduce to better work.

4. Unit cost of all work should be maintained and the keeping of these records will more than pay for the cost of the clerical work involved.

All agree that special effort should be made to get intelligent drivers who are willing to take pains to do the work at each house in a cleanly fashion. Others urge keeping one man on the same route.

In planning districts and force, the findings of the Chicago Civil Service Commission may assist some officials. It required on an average under ordinary conditions three hours and fifty-five minutes to collect a full load of two and one-half tons. The average in summer was 3.9 hours and in winter 4.7 hours. The average rate of haul was 3 miles per hour in summer and 2.7 miles per hour in winter. Collections were at a minimum in winter and a maximum in summer, especially in September. The quantity collected

from several districts for different years was not constant, but continually decreased or increased, depending upon local conditions, such as change of character of population, growth of residence, business and manufacturing. The fluctuations make it necessary that the organization be flexible and easily adapted to changing conditions.

As the quantity will vary from season to season, the collector assigned to a district should make daily reports of work performed and territory covered. By so doing it can easily be determined whether he is delinquent or the work has increased so as to require auxiliary equipment or extra assistance. The plan is also valuable for rearranging districts.

The Ohio State Board of Health has expressed the belief that the routes should be so arranged that each collector covers about the same mileage and so that each wagon is as near as possible to the point of disposal by the time the wagon is loaded in order that the productive time of the collector, or the time he spends in collecting from houses, may be as great as possible and his unproductive time, or the time he spends in driving his loaded wagon to the point of disposal, as small as possible. In some cities, owing to poor routing, the unproductive time has been as high as 40 per cent. of the collector's working hours. Routes should also be so arranged that grades are climbed with light loads and descended with heavy loads.

Receptacles and Vehicles

Most cities specify a standard sized can. It is agreed that this is necessary to secure the best results. The size varies in different cities and with the type of system. All reports show that the can should be metallic, water-tight and as nearly air-tight as possible, and should be securely covered. A 20-gallon can, it is claimed, will take care of an average size family for a week and is easily handled by the

collector. The size of the can should be limited so as to be easily handled by one man.

For collecting garbage many types of wagons are being used by American cities. The design materially affects the cost and efficiency of results. Most cities are now using a steel tank wagon with either a bottom or rear dump, depending upon the house treatment of the garbage and whether the system is combined or separate. All reports show that any garbage wagon to be sanitary and satisfactory must be metallic, fitted with covers, easily cleaned and disinfected, and as large as consistent with the grades and type of pavement on the routes traversed. Particular attention should be given to the loading height. This should be at a convenient distance from the ground so that the collector can easily empty the can. The arrangements for dumping are also important. They should be quick and simple. It is claimed that bottom dumping wagons are best, but these cannot be used for raw garbage unless wrapped. They can be used for mixed refuse. Many cities successfully use the rear dump wagon, which is tilted by a hand-turned gear at front.

The right kind of cover is also important. Greeley says the most satisfactory cover is the light fixed roof, arched over the top of the wagon at sufficient height to give a free space above the whole of the garbage, and to allow trap doors in the side of the wagon for emptying the can. Many cities use canvas covers. The Worcester Waste Commission reports that its inquiries show that wooden or iron covers are impracticable because they do not allow expansion of load during periods when the amount of garbage is greatest. It says that wooden covers warp, do not fit tightly and need repairs often and are much in the way during collection. Iron covers, it avers, are almost universally condemned on account of their weight, and if very light get out of shape easily, wear loose and in a short time become a noisy nuisance. Some types of wagons are equipped with rubber buf-

fers to lessen the noise and others have automatic covers.

Wagons made for garbage collection range in cost from $150 to $375 each.

The capacity of the average garbage wagon has been from a yard to two yards cubic contents. The tendency in many large cities is to increase this to four and five yards and even larger. Greeley believes that a wagon having a capacity of about three cubic yards is desirable.

A few cities which have adopted the can collection system have wagons built with two tiers. Some are using automobile trucks constructed in this way. The Ohio State Board of Health, in its report, says that platform wagons are somewhat less economical than tank wagons but are entirely suited for small cities where the quantity is not large.

It seems to be the opinion of those who have had experience that automobile trucks for refuse collection are neither economical nor convenient, owing to the many stops and starts and the slow general progress. None of the 224 cities from which data have been received uses automobile trucks exclusively. Several have automobile trucks in service but practically all of these use them for hauling from transfer stations over long distances to the place of disposal. At some of these loading stations a crane is used to lift the detachable body or tank from the wagon and place it on the truck. Another method adopted by a few cities is to use wagons for collection and tractors for hauling. The horse drawn wagons when filled are taken from a common meeting place to the disposal site by a tractor which draws them as a trailer. The horses are hitched to empty wagons and continue collecting.

R. T. Dana has compiled statistics which will interest those who contemplate using motor trucks. He says for hauling ashes, street pavement, etc., it is cheaper to use horses if the haul is less than one mile. If motor power is used for a haul of a quarter of a mile the loss is 1.8 per cent.; if half a mile, 9.1 per cent. loss. For one mile haul

there is no difference in cost. Above that the saving is in favor of motor trucks. Similar investigations have been made at the Massachusetts Institute of Technology. These show that for distances greater than 1.7 miles, electric driven vehicles are cheaper than either horse drawn or gasoline driven and that gasoline driven are cheaper than horse drawn.

Investigations made by the Efficiency Division of the Chicago Civil Sevice Commission showed that electric trucks are more efficient than gasoline trucks where the short hauls with many stops are encountered. Its conclusion was that for the long hauls electric trucks were more economical than horse drawn or gasoline driven trucks. The following table gives a detailed comparison of the advantages of gasoline and electric trucks as determined by the Commission:

Gasoline Truck	Electric Truck
(a) Greater average speed possible.	(a) More efficient where the haul with many stops are encountered.
(b) Can be run continuously day and night.	(b) More efficient within its limits of operation, 50 to 60 miles per eight hour day.
(c) Are essential outside of the radius of operation of the electric truck.	(c) More economical motive power.
(d) Can do more work in a given time if speed restrictions do not interfere.	(d) Less average per cent. maintenance and repair costs.
(e) Less balking on unimproved streets.	(e) Less per cent. depreciation.
	(f) Requires less skill to drive.
	(g) Affected less in winter by temperature.

The Commission's study led to the following conclusion: "That at the present prevailing cost of team hire the saving in the use of electric motor trucks for hauling garbage in such wards as have a considerable haul, would amount to 5.1 per cent. of the total cost of removing such garbage by teams. 2. That either the gasoline or electric power trucks can handle the hauling of garbage with approximately equal satisfaction. 3. That the more economical power truck has been found to be electric. This is governed in a measure by the low cost rate of electrical energy from the Sanitary District to the city for night power and by the fact that the rates for depreciation, maintenance, repair and insurance

are less than for the gasoline truck. 4. That the haul below which an electric truck carrying three tons would not be economical when measured against a $5.50 per day team is found to be about 1.8 miles and when measured against a $6 per day team is 0.8 miles. 5. That the three ton gasoline truck at present cost price would not haul economically when traveling in the city at the economical rate of speed, as would the horse drawn vehicle at either $5.50 or $6 per day and traveling at the rate of speed found by experiment on garbage wagons."

Greeley believes that the cost of loading a motor truck will be greater per hour and the rate of load will have to be increased proportionately to make the cost comparable with loading a team drawn wagon. The cost of hauling by motor will be less. He contends that the use of trucks in refuse collection service will increase and that the cost of loading can be reduced by limiting the motor truck to transportation after the loading of the wagon by the tractor and trailer system.

St. Louis recently made computations comparing the existing cost of hauling garbage from the long haul district with mule teams and the probable cost of haul with or by tractors. The motor apparatus was assumed to be a Knox tractor with two trailers and the assumed haul of seven miles. This would replace ten teams. The investment for a ten-ton tractor would be $3,750, and two trailers, $1,000, with a total of $4,750 for the motor apparatus. Ten teams of mules cost $3,000 and ten wagons, $1,350, a total for animal power of $4,350. The cost of operating per day is assumed to be for the motor, making three trips a day, 42 miles, $4.07.

10 teams cost the city	$20.00
10 drivers	16.50
Repairs	.73
	$37.23

This computation assumes a loading station located at the center of the long-haul district, which, including lot, building, paving, platform, sewer and water connections, would cost $6,300. The equipment would therefore be $10,650. Interest on the investment is computed at 6 per cent. The annual charges against the motor equipment would therefore become $3,034.92. The year is assumed at 156 days, as the district is collected from three times a week. The charges against the team equipment amount to $6,503.88. The saving in adopting the truck system is thus $3,468.96 a year from this long-haul district. Under these assumptions the equipment is idle one-half the time.

The New York City Department of Street Cleaning made a test of motor trucks and proved their efficiency over the present system, giving a possible 18 per cent. for time lost in hauling, loading and returning light as against 43 per cent. under the existing system. A ten-year test in England proved the superiority of motor trucks.

The Worcester Commission reports that for heavy, long hauls and under conditions where a truck can be kept moving, a motor truck is probably more economical than a horse drawn vehicle of the same capacity. It concludes that the motor trucks are not economical for short hauls with many stops.

The Health Commissioner of Seattle in 1913 made the claim that auto trucks save from one-fourth to one-fifth as much time as is consumed by horse drawn vehicles. He expressed the belief that 45 cents on a dollar is saved by using auto trucks. Seattle hauls its garbage by auto from bunkers to place of final disposal.

A few cities haul from transfer stations to place of final disposal by trolley and steam cars and by barges. Greeley estimates that assuming 600 cu. yds. of refuse weigh 375 tons, the cost of trolley transportation will be 40 cents per ton. Barge transportation, he estimates, will be about 22 cents per ton. Transportation by steam railroads, he says,

depends upon switching charges. These will range from $5 to $15 per car. He figures the switching charges will average about 20 cents per ton.

Collection Regulations

The location of the receptacle and the time and frequency of collection have a very important bearing on the efficiency and cost of the service. The degree of cleanliness desired and the convenience of the householder are the chief factors which determine these questions.

Most cities specify where the can must be left for collection and to what place it must be returned. Some collect from the curb, areaway or alley, but the majority of them take the can from and return it to the house or back yard. Garbage can be collected much more speedily if the cans are left at the curb for collection days, but most cities object to the unsightliness of the thoroughfares which results. The citizens, for their own convenience, and to eliminate the objection of a littered street, are willing to pay the extra cost of having the garbage taken from the yard or the house.

The almost universal practise in America is to collect garbage during the daytime. Of those from which facts have been received and whose systems are described in the accompanying tables, only two collect all garbage at night. One collects at night during the summer and four collect at night in the business section. Two collect during both day and night.

The number of collections made in a stated period of time depends entirely upon the amount of garbage, the density and character of population, the climate and the season of the year. Some cities maintain a daily service in all except the outlying sections. Practically all collect at least once a week. In cold climates more collections are required during the summer than during the winter. Usually the collections are more frequent in the business sections than in the residential sections and less frequent

in the outlying districts than in the residential sections, the density of population being the determining factor.

As with ash collection the promulgation and enforcement of specific regulations are very helpful in increasing or maintaining the efficiency of a garbage collection system. Cooperation of the public is essential and this can be secured to a great extent by an efficient system. All reports agree that regular collections should be made at stated intervals and so far as possible at the same time each day according to a regular schedule. Laxity on the part of the collection department will breed indifference among the householders. The Chicago Waste Commission expresses the opinion that where the householders become accustomed to a systematic service they will depend upon the collector and will more readily comply with laws and ordinances. All experts agree that the regulation as to house treatment of refuse should not only be enforced, but that considerable time should be spent by officials in educating and training people to cooperate for mutual advantage. Such time will be well spent, and eventually it will reduce the cost of operation.

The rules and regulations respecting the collection of garbage and refuse in a small progressive New York State city are as follows:

"All persons intending to have their ashes, garbage and other refuse removed by the collector, shall provide sufficient standard ash cans, sixteen to twenty inches in diameter, and twenty-six inches high, manufactured of galvanized iron with proper handles and cover.

"Into this can should be put old bottles, rubbers, tin cans, broken bottles and glass, old shoes, sweepings, paper and other rubbish.

"Ash cans containing swill, water, offensive and decomposing material, or the contents of which are frozen and not easily removed, will not be emptied by the collector.

"Provide sufficient garbage cans composed of galvan-

ized, G. I. Standard make, with covers and handles, to hold one week's accumulation. Put into this can all swill and other kitchen refuse. Garbage cans containing ashes, old bottles, tin cans, glass, shoes, sweepings, paper or other rubbish, or the contents of which are frozen, will not be emptied by the collector.

"The cans must be placed where the collector can conveniently have access to them, and if placed on the sidewalk or in front yard, must be returned as soon as emptied.

"The collector will collect but once each week and on the day and at the time specified for the street on which you reside.

"Burn as much rubbish, paper, sweepings, etc., as possible.

"Piles or accumulations of garbage, old bottles, tins, papers and any other substances, liquid or solid, or of anything that may become a breeding place for flies or mosquitoes, or which in any way may become a nuisance, are prohibited.

"Accumulations of garbage or other refuse of more than one week is prohibited.

"Any incivility on the part of any collector, or any complaint should be made at once in writing to the Clerk of the city."

Cost of Collection

The cost of collection is vitally affected by so many different factors and by local conditions that any attempt to compare the economy of the system in one city with that in another will generally be unsatisfactory. Also actual cost data are kept by very few cities, and where they are available the methods of determining them often vary so that they are misleading for comparative purposes. The cost depends upon the cost of loading and the cost of hauling, as described in the discussion of ash collection. Such facts about the cost as are available in printed reports and as have been sent to the New York State Bureau of Municipal

Information by the cities will be found in the accompanying table.

An investigation by the Ohio State Board of Health in Ohio cities showed that the cost averaged from $2 to $2.75 per ton. The report says that the cost of collection in Cleveland for several years averaged $2.17 to $2.79 per ton; Dayton, $2.11; Zanesville, $2.13. In the smaller cities where hauls are comparatively short, the cost frequently did not exceed $1.50 per ton, and "on the average with proper routing should not exceed $2.00 per ton."

The cost of the collection and disposal may be met by a draft on the general fund, by assessment upon property benefited, or by assessment upon the people directly served. The particular method selected will be determined by the legal limitations, the difficulty of collection, tax limitations, and so forth.

Per Capita Production

Experts have agreed within fifty pounds as to the per capita garbage output of a community. W. F. Morse, Sanitary Expert, gave one hundred and ninety pounds per capita per year as approximate figures for an estimate. William N. Venable estimated the annual amount per capita to be from 150 to 200 pounds.

Recent reports from six cities which have complete collection systems show considerable variation in the per capita amount collected. These cities report as follows:

	Lbs. of Garbage per Capita
Columbus	203⅛
Grand Rapids	97
Buffalo	80
Worcester	127
Rochester	260
Cleveland	162

The average weight of garbage per cubic yard according to statistics from nine large American cities has been from

1,100 to 1,475 pounds, and the number of pounds per one thousand of population per day from 331 to 875.

The food conservation campaign throughout the nation since our entry into the world-wide war, however, has created havoc with garbage production figures and estimates. Although it was known for many years that the American housewife has been a most notorious profligate in the waste of food, it was not until the war forced upon America the necessity for food conservation that there was any decrease in the contents of the garbage pail. Remarkable changes have been reported by cities, the following reductions by New York State cities being typical:

Name of City	Amount of Garbage Collected During			
	June, 1916	July, 1916	June, 1917	July, 1917
Rochester	2563 tons	2580 tons	1,870 tons	2,167 tons
New York City (Boro. Manhattan)	82,503 cu. yds.	89,568 cu. yds.	76,550 cu. yds.	84,628 cu. yds.
(Boro. Brooklyn)				
Kingston	140 tons	140 tons	120 tons	120 tons
Cortland	37½ tons	37½ tons	31¼ tons	31½ tons
Schenectady	312 tons, 680 lbs.	350 tons	330 tons, 655 lbs.	398 tons, 1,400 lbs.
*Syracuse	1,100 tons	1,373 tons	1,062 tons	1,087 tons
Albany	954 bbls.	1,094 bbls.	786 bbl.	877 bbls.
Buffalo	2,319.770 tons	1,250.280 tons	2,247.790 tons	1,748.700 tons
Utica	40 tons daily	40 tons daily	35 tons daily	35 tons daily

* Increase probably due to change from contract to municipal system of collection.

Omaha, Nebraska, reports that for the year 1917 the bulk of garbage was about the same as the previous year, but that no meats, bread or potatoes were found in it. The collection of garbage has been a little over one-third less since the conservation of food went into effect.

What percentage of this reduction will continue after the war is problematical, but it is agreed by all experts that never again will the American garbage pail be so productive as it has been in the past.

Garbage Disposal

A choice of seven methods is offered for the disposal of garbage. They are feeding to swine, dumping on land, dumping into large volumes of water, disposing by sanitary fill, burial, incineration and reduction. In selecting its dis-

posal system a city should bear in mind the importance and cost of a collection system.

Some cities collect and dispose of their garbage by contract, others collect by contract and dispose of it themselves, or vice versa, and still others have all the work done by the municipality. Experience has proved that a city can operate a disposal plant just as efficiently as they can a collection system.

Feeding to Swine

Most of the smaller cities in this country dispose of a part of or all their garbage by feeding to swine, but so far as the State Bureau of Municipal Information has been able to learn, only four maintain municipal piggeries. These are Worcester, New Haven, Brockton, and Taunton, Massachusetts. The others either collect their garbage by contract and sell it or give it to farmers or those operating piggeries, or maintain a municipal collection and sell to a contractor who maintains a piggery.

Among the cities which dispose of their garbage by feeding to pigs and derive a revenue are the following:

Denver, Colo.—Collected by a Hog Growers' Association which disposes of it by feeding.

Cambridge, Mass.—Sells to hog farmers at 70c. per cd. foot and has no difficulty in disposing of all. Cost of collection, $50,000 a year; receipts, $16,000 a year.

Grand Rapids, Mich.—Sold to live stock company for 45c. per ton f. o. b. cars. Last year collection cost $28,659 and receipts were $4,450.20.

Camden, N. J.—Incinerator burned and since then garbage has been collected and fed to hogs.

Brockton, Mass.—Municipal piggery (description below).

Colorado Springs, Colo.—Contractor pays $1,440 a year for the privilege of removing all table refuse from

city. Feeds to hogs. Garbage must be sterilized before feeding.

Salem, Mass.—City Poor Farm uses about 200 loads a year. Remainder is sold to contractor, who pays $13,255 for five years. Last year city paid $10,948.30 for collection.

Taunton, Mass.—Municipal piggery.

Somerville, Mass.—Sold to farmers for 50c. per cord foot. Cost of collection last year, $25,134.80; receipts, $8,865.50.

Lawrence, Mass.—Sold for $1.25 a load. Ready and increasing demand. Two loads used daily at Poor Farm piggery. Cost of collection, $10,000 a year. Estimated receipts, $6,000 a year.

New Haven, Conn.—Cost of collection, $18,000 a year. Fed to hogs on farm owned by city (description below).

Fall River, Mass.—City pays contractor $7,800 a year for the removal of garbage. He feeds it to pigs on farm owned by him.

Worcester, Mass.—Municipal piggery (description below).

Corning, N. Y.—Contractor pays city $122 a year for privilege of collecting at 10c. a can. Garbage taken by him to his hog farm.

The city of Brockton, Massachusetts, owns the land and buildings necessary for feeding swine, also the horses and teams necessary for collection. The Mayor's office reports that the city has not been able to make any profit on this method of disposal. In fact, for the last ten years the average cost to the city has been about $5,000 annually.

Taunton, Massachusetts, collects garbage only in the center of the city. The remainder is taken by private parties. The city has only two teams and two men at work. The Secretary of the Board of Overseers says that "in con-

sequence of doing things in this way it is of little or no expense and gives quite good satisfaction."

The expense and receipts during one year for the piggery were as follows:

Wages of employees	$1,299.90
Expenses, not including board of two horses belonging to department	375.92
	$1,675.82
Receipts from swine	3,260.91

New Haven, Connecticut, pays $18,000 a year for the collection of its garbage, which is hauled to a farm rented by the city and fed to hogs owned by the city. The Board of Health reports: "Outside of some complaints from the piggeries we have got along. Our Board has repeatedly recommended the destruction of the same, but as yet nothing has materialized."

A special commission made an investigation and report on the collection and disposal of municipal waste in Worcester, Massachusetts. After investigating all methods of disposal it reached these conclusions: "That the disposal by feeding is the most economical method; that the greatest intrinsic value of the garbage, the feeding value, is made use of; that the garbage of Worcester can not only be disposed of without cost but that the revenue from the sale of hogs has almost been sufficient to pay for the collection."

The Commission recommended that the present method of feeding to swine be continued.

In its report it gives the per capita cost of collection and disposal as $.072 for Worcester and $.095 for Brockton.

The Worcester municipal piggery is the largest and most successful. The garbage collected by the city is fed to a herd of hogs numbering about 1700 in winter and 4000 in summer. During the winter practically all hogs are housed.

The necessity for sterilizing garbage before it is fed to hogs is disputed. Salem, Cambridge, Grand Rapids,

Taunton and Brockton report that garbage is not sterilized. New Haven reports that some is sterilized. Colorado Springs and Omaha require all garbage to be sterilized.

In his report of the sanitary survey of St. Joseph, Missouri, J. H. White, Surgeon, United States Public Health Service, makes the following statement with regard to the disposal of garbage in that city:

"Kansas City, Providence, Denver, Omaha, Colorado Springs and other cities have their garbage fed to hogs, with the uniform result that the cost of removal is reduced to some extent to the city and that the contractor, according to his business capacity, is able to make more or less profit from the feed so obtained. There is no danger in this system under proper handling. Any supposed danger to the hogs can be prevented by prompt handling of the garbage to prevent unnecessary fermentation and by the use of the hog cholera serum to prevent disease. The proper cleaning of the pens, if in the city, eliminates any danger to man. The Board recommends this system and I heartily concur with them that it offers the best available solution of the garbage problem."

The Worcester Commission reports the figures for hogs sold to a packing company during the last year from the Home Farm. Of the 2,276 hogs sold, the Commission says only 11 were condemned by the United States Government Meat Inspectors, an average of only 0.48 per cent. of one per cent., which average is much lower than it is on hogs shipped in from the West to the same packing house. It further says: "The feeding method, however, has been practised with success in many cities, especially those in New England, for many years. The great difference of opinion is explained by the efficiency with which the sanitary conditions at the farm are maintained." It emphasizes the fact that farms must be kept clean and in a sanitary manner, and that this method of garbage disposal requires careful and

intelligent supervision, as is the case with any other method of disposal. No method of disposal will run itself.

Following are comments received regarding this particular plan of disposal:

Health Officer C. C. Slemons, of Grand Rapids, Michigan, says: "From observation I am of the opinion that one of these farms (municipal piggery), properly conducted, is a paying proposition, but I do not think to the extent of paying for collection. From my observation I would be rather skeptical of a city going into this business. It is a business that needs very close supervision and unless a person is financially interested in it I doubt very much if the experiment would pay."

Mayor Fred. W. Keller, South Bend, Indiana: "Some of this work was done several years ago. However, there was some objection on the part of taxpayers to it being hauled out of the city with municipal teams. It should be fairly profitable, but the farm and hogs should be owned by the city or the garbage disposed of to the concern that does own the hogs and farm and this done by receiving competitive bids. I make this latter suggestion in order to avoid criticism by taxpayers."

Lawrence, Massachusetts, reports: "Those who have looked into this question contend that the city swill can be utilized to support a municipal piggery at considerable profit."

In a recent report, the Iowa State College says of this method of disposal: "The only advantage which may be stated in favor of this method is that it probably costs less, under existing conditions about most of our cities, than any other available method."

In one of its annual reports, the Massachusetts State Board of Health says: "It is objectionable and unsanitary in the extreme, as health authorities are constantly pointing out. Prominent among the objections to this method are the great nuisance it usually creates and the uncertainty of

its operation." The Board says epidemics among pigs create the uncertainty of operation. It also says that they are breeding places for flies and rats.

The Chicago Waste Commission's comment on this method is that it is not applicable or desirable in a large city, except under inspection and for restricted private collection.

The *New York Medical Journal* reported that the garbage collected by Grand Rapids, at cost of $26,320, is taken by a contractor who last year paid 45 cents per ton and fed to hogs. It says that over 10,000 hogs are sold yearly at a value of $135,000 and that 2,400 tons of fertilizer are produced at a value of about $36,000.

Samuel A. Greeley, Sanitary Expert, says that 75 pigs are required to dispose of a ton of garbage per day. The equipment at the farm prescribed by him is: Tracks and cars for distributing the garbage along concrete feeding platforms; substantial and well-kept sleeping and warming pens; tanks for sterilizing garbage; apparatus for vaccinating pigs against cholera; a means of disposing of unconsumed garbage by burial or incineration and plenty of washing facilities. He further says: "There should be some method of sorting the garbage before feeding it to pigs so that the stale garbage may be discarded and buried or burned. Some places disinfect it by boiling in large caldrons before feeding. In such cases the cooked garbage is commonly used only as a base for the feed given to pigs. The method is a most profitable one and warrants consideration in small cities where isolated farm sites are available."

Dumping on Land

It is the consensus of opinion in all reports and of all experts that this method is objectionable especially where there is a large quantity to be disposed of. A long haul is necessitated by the location of the dumps at a remote distance where the decomposition of any part of the refuse will

not be offensive to neighboring property owners. When the garbage is deposited in sufficient quantity offensive odors due to fermentation and decomposition may create a nuisance. Unless special attention is given to the treatment of these dumps, this method will not be found desirable. A thorough mixing of garbage with ashes and rubbish will prevent the nuisance and the fires that are otherwise liable to occur, creating odors and nuisance from the smoke and unconsumed gases.

A report of the Iowa State College states that dumps where ashes and rubbish and other refuse are deposited are not only unattractive in appearance, but are detrimental to the health of those living in the immediate vicinity, and as a city grows, it usually becomes increasingly difficult to find locations where these dumps can be maintained without incurring the objections of those living in the neighborhood.

The *Scientific American* says this method "is one that cannot be defended either from an æsthetic or sanitary standpoint. The dumps become an ideal breeding place for flies."

Dumping in Large Bodies of Water

Only a few cities use this method. In most places where it has been tried, it has been prohibited because the material is washed on the neighboring shores

Disposal by Sanitary Fill

This method is practised by some cities, among them Seattle, Davenport, and New Orleans, which report its success. It is given more serious consideration than heretofore by several large cities. The method is different than that of burial, in that it is carried on by filling excavations, vacant low lying ground and natural ravines.

The garbage, rubbish and ashes are dumped and then mixed with sufficient earth to insure oxidation and thorough digestion of the decomposable wastes. The activity of the

bacteria of the soil breaks down and mineralizes the organic matter and when there is sufficient oxygen, *i. e.* air, no putrefaction or other odors result. Success depends upon the following treatment:

(1) The garbage must not be buried so deep that bacterial activity is reduced.

(2) The garbage must not be spread in a thick layer on the surface of the ground.

(3) The ground must be sufficiently open and drained so that air can penetrate to a sufficient depth.

(4) The garbage must not overload the soil, but must be sufficiently diluted with earth, ashes and rubbish, so that putrefaction may take place, due to the presence of an ample supply of air in the pores of the soil.

The Chicago Waste Commission believes that this method "has been demonstrated to be not only sanitary, free from nuisance when properly carried out, but economical as well." Incidentally, adds the Worcester Commission, it adds valuable taxable property from which the city subsequently derives an income.

At Davenport, 1.3 cubic yards of materials are required per ton of garbage and the total cost of upkeep, including rent of land, labor, etc., was 50 cents per ton. The garbage is received and buried by one foreman and three men in summer and one foreman and one man in winter. The city by this method is creating a valuable river front.

New Orleans seeds its dumping grounds as soon as a sufficient filled area is available, and later trims and plants the land for use as small parks and play grounds.

The Health Commissioner of Seattle, in a letter to the *Municipal Engineering Journal,* describes the system and results as follows:

"This method of filling works very satisfactorily in this climate, but I believe it necessary to include all waste materials, as ashes, boxes, tin cans, etc. These all assist oxygena-

tion and nitrification. I do not believe pure garbage can be handled in this way.

"We also find that it is best to keep as little of the face of the fill exposed as possible. It is always best to keep a man constantly on the job, whose duty it is to rake down to the bottom of the fill all boxes, rough materials, etc., thus leaving the ashes to form a covering on top. When this is not sufficient, we cover with a layer of earth about five inches thick.

"The success lies in the proper mixtures of waste materials, and next the fill must be properly covered to protect from flies. Chemicals can also be used to protect it. This covering also prevents the slight sour odor of fresh garbage and by keeping out the sunlight, at the same time encourages bacterial growth by increasing the warmth inside the fill. People residing within one hundred feet of these fills make no complaint, but the public has to be educated when you first adopt this method. We aim to fill city property, as ravines, swampy lands or docks on the lake or salt water front.

"Our laboratory findings show that the process is simply one of slow incineration by nature, instead of the expensive method of burning by incinerators, and at the same time help prove that there is nothing detrimental to public health in these fills.

"We have eleven fills distributed over our city, thus making short hauls, and these are taken care of by eleven laborers disposing of approximately three hundred and fifty tons per day by this method alone, while one incinerator with about an equal payroll will only dispose of sixty to seventy-five tons per day, running twenty-four hours. A fill increases the value of property, while the refuse from our incinerator has to be hauled away at an added cost."

After spreading, there is applied to the garbage an antiseptic spray of crude carbolic acid, rosin and caustic soda

to kill eggs and larvæ of flies, mosquitoes and other insects that might breed.

Burial

Garbage may be buried by putting it in shallow trenches and covering with the excavation from the trenches for the next day's deposit, or by plowing under. It digests and is thoroughly taken up by or oxidized by the action of the soil. Experience has shown that for open soil 1.5 acres are required to handle each daily ton of garbage for one year, the same soil being in shape to re-use after two years. For heavy soils and those containing clay, about three acres are required and this can be used again after three years.

The Worcester Commission reports that cities which have buried by plowing have experienced more than occasional nuisance. Milwaukee and Columbus successfully disposed of their garbage by burying in trenches, before they constructed disposal plants. Milwaukee paid forty cents a ton to dispose of its garbage by this method.

A summary of the opinions indicates that disposal by burying when properly conducted and when the point of disposal is suitably located gives no cause for objection from a sanitary standpoint. The principal objections are the extremely long haul, the amount of land necessary and no direct income. In small communities this method is entirely satisfactory. It is usually not applicable to large communities.

Disposal Plants

There are two methods of disposing of garbage in plants —incineration and reduction. There is a wide diversity of opinion among experts and city officials as to which is the better from a sanitary and financial standpoint. There is, however, nearly universal opinion upon the following:

1. That the revenue from the by-products of municipally owned and operated plants will not pay the combined cost of collection and disposal.

2. That with only a few exceptions the revenue from the by-products of municipally owned plants does not pay the cost of disposal.

3. That the price received by cities from contractors is, with very few exceptions, not sufficient to pay the cost of collection.

4. That the disposal of garbage by the reduction process is uneconomical for a city with a population of less than 100,000. Some experts increase the size to 150,000 and one to 200,000.

5. That incineration is better than reduction for a city with a population less than 100,000.

The reduction in the per capita production of garbage, due to less wastage of food in the American home since the war, may make it necessary in the future to increase the size of the city which can profitably employ the reduction method, or should use the reduction method.

In the report of the Chicago Waste Commission, some general rules are laid down for the design of a disposal works, irrespective of method. It says that the design should permit the plant to be operated as a whole, or in part, so that each part can be operated as an independent unit. This will permit one or more parts to receive attention and be repaired during the season when the minimum quantity of refuse is to be disposed of. The details of the plant should be such as to permit cleanliness at all times and hosing and washing so as not to permit garbage dust or dirt to accumulate, flies to breed and material to decompose. All material, so far as possible, should be enclosed during the process of disposal, and the odors eliminated or confined or deodorized. The handling of material in the plants, so far as possible, should be eliminated, where mechanical means can economically be adopted. Special attention should be paid to ventilation and the elimination of dust where men are required to work.

The odors or nuisances caused from disposal plants will

usually arise from one or more of the following sources: Garbage or refuse, incomplete combustion or combustion temperatures not sufficient to eliminate odors, congestion of carts in one locality and creation of dust. The odors arising from raw garbage which are found in all plants are mostly local and will not create a nuisance a short distance from the point of handling and the housing of equipment used in hauling.

A method of determining the kind of a plant to be built and operated which will meet with local conditions is described as follows by Rudolph Herring, sanitary engineer.

"Locate suitable central points where incinerators can be built convenient for reception of refuse and delivery of steam and clinker. Estimate annual cost, including fixed charges and operation, as follows: First, of wagons and other means of collecting from house to works all garbage, ashes and rubbish combined; and, second, of the works for incineration. The sum of these two estimated costs will give probable annual cost of entire plant from origin to finish. This sum must then be credited with the annual value of steam and clinker. The result will be the net annual cost to the city of collecting and finally disposing of the above parts of general refuse.

"A. Locate suitable place where reduction process can be carried on economically and conveniently for reception of garbage and delivery of products, with a capacity to serve, if practicable, the entire city. Estimate annual cost, including fixed charges and operation, as follows: First, of wagons and other means of collecting the garbage from house to works; second, works for reduction. The sum of these two estimated costs will be the probable annual cost to the city of the collection and reduction of the garbage. This sum must be credited with annual value of products of reduction, as derived from sale of oils, grease and fertilizers. The result will be the net cost, perhaps profit, of disposing of city garbage.

"B. Locate suitable central point where incinerator can be built, which will be convenient for the reception of ashes and rubbish and the delivery of steam and clinker. Estimate annual cost, including fixed charges of operation as above of the collection and works for disposal of ashes and rubbish, if these are to be incinerated together.

"If only rubbish is to be collected and delivered for incineration, then there should be added the cost of collection and final disposal of ashes by dumping. This cost should again be credited with annual value of steam and clinker and perhaps of landmaking by dumping of ashes.

"By adding results of A and B, we obtain the total net cost to a city of collecting and finally disposing of the above parts of general refuse. A comparison between these estimates of cost, of both collection and incineration of garbage, ashes and rubbish as one project and of both collection and reduction of garbage and the collection and incineration of rubbish and dumping of ashes as the other project, will indicate the most economical method in the city for which these cost estimates have been made. It is necessary to analyze carefully local conditions to determine the most economical method."

Incineration

Two kinds of plants are used for this method of disposal —crematories and destructors. Many destructors are in operation in America, but of the crematories which have been built, many have been abandoned. Heat for destruction must be obtained not only from the garbage itself, but also from ashes and other combustible waste. It is here that the difference between destructors and crematories enters. In the former, heat is obtained from the refuse itself; in the latter, garbage is burned at the expense of coal, wood or oil. It seems to be the prevailing opinion that in order to make incineration a success the material must be burned at a high temperature and rapid rate of combustion.

Morse claims that destructors require twenty per cent.

less area of ground, cost fifteen per cent. more for boiler and machinery; that the construction is more durable; no addition of fuel; that the gases of combustion are consumed, and that this method has by-products of clinker and power and destroys all combustible refuse; and that the net cost of operation is less per ton.

Crematories, Morse says, require more ground and more time for disposal, but cost less. They are less durable, require addition of fuel, gases are incompletely destroyed, cannot develop power, the residue has no value and they can burn only garbage and rubbish. The gross cost of operation is a trifle less, but the net cost is more.

Tests of garbage crematories in Ohio, according to the State Board of Health, show that "the plants as operated fail usually to dispose of the garbage at a temperature high enough to avoid the production of odors." This, says J. T. Fetherston, Commissioner of Street Cleaning of New York City, is significant and conclusive.

Regarding mixed refuse destruction, Fetherston says: "Three features may be noted: No added fuel is required, steam power is produced and quite a residue (clinker) results. Compared with tests of garbage crematories the average destructor temperatures in connection with the gas analyses indicate freedom from odor due to unconsumed gas. Thus the mixed refuse type of plant corrects the inherent defects of the garbage crematory."

The cost of incineration plants depends upon the garbage to be handled. The various incinerator companies usually estimate the capacity of the plant at about one ton per 1,000 population.

Reports show that disposal by incineration in Ohio is confined to cities of from 20,000 to 80,000 population, and that its success has been confined to the very large and to the rather small cities of the country. Some assert that it is applicable in the very large cities only when the collection systems are suitable to provide for the burning of mixed

refuse. In small cities it is the custom to cremate the garbage alone, the other classes of waste being dumped or buried.

The cost of construction, reports show, ranges from $600 to $1,000 per ton capacity. The Worcester Special Waste Commission says that "from a calculation based on some 30 incinerators it has been found that the cost per ton daily capacity varies from $250 to $1,000, the average being between $600 and $700."

The by-products are clinker and the steam generated.

Robert W. Wylde claims that the cost of operating destructors "is in a great measure offset and frequently quite overbalanced by the revenue" from the sale of steam and clinker. One hundred tons of refuse burned during 16 hours a day produces 800 engine H. P. Clinker from 100 tons might amount to 30 tons per day and would bring $1.00 a ton in many localities. Another expert says that one pound of refuse has been found to produce one-half to one and three-fourths pounds of steam. The value of refuse as a fuel is estimated by one expert to be 49 cents per ton.

The Chicago Waste Commission's report points out, "that experience in connection with the development of power from refuse furnaces demonstrates that it is not easy to find an available use whereby the power can be utilized regularly as produced and the furnace operated continuously. In the majority of plants constructed, it has not been possible to utilize all the power available, and in most cases the use is limited to the operation of the plant. When power developed is used in lighting and power stations, the demand only comes during a part of the day. Supplementary coal-fired boilers are usually found in connection with destructor-electric lighting stations, or else the destructor is much larger than would be required to deal with the refuse alone. The power produced from refuse furnaces will be best utilized by some local industry, such as ice-making plants or electro-chemical plants, which require

continuous operation. When power is used in connection with pumping plants, it is found good practise to operate the refuse plant only as an auxiliary to the power plant of the pumping station. The saving that results or credit that can be given the destructor plant will amount to the value of the fuel equal to that which it requires to produce the amount of steam developed and used. The fluctuating amount of power developed in most cases can be depended upon only for the average minimum production. In selecting a site for a refuse disposal plant from which power is developed it is not always profitable to utilize the power where the demand is not constant and where the demand would be constant, suitable sites are not always available."

William M. Venable, sanitary engineer, believes that if a city has a steam power plant, it will pay, but it will not pay to build one for that purpose.

In a suburb of Montreal, the refuse destructor is constructed in connection with a municipal electric light power station and power is used in generating electricity for lighting purposes. The plant is operated only during the time when lighting load is in demand, and the material as delivered is stored during the day and burned at night. Only a part of the power is furnished by the refuse furnaces, the remainder being obtained from a coal-fired boiler plant.

In Savannah, Georgia, the water works boilers are kept in service, with banked fires, to use in case of shortage of garbage.

The following are some of the reports from cities which receive a revenue from by-products:

Minneapolis: The steam generated lights and heats hospital and workhouse buildings, also lights 31 miles of streets. Estimated annual revenue, heat $6,293.89; light $1,080.62; street lights ($60 per arc) $4,657.48; total, $12,031.99.

Borough of Richmond, New York City: West New Brighton incinerator uses clinker in manufacture of brick by mixing cement with ground clinker.

New Orleans, La.: Plans perfected to light streets and public buildings. Claimed that from 500 tons of garbage daily 30,000,000 K. W. can be generated a year.

Savannah, Georgia: Ninety-five per cent. of coal fuel previously used at pumping station is now saved by destructor. To operate water works pumping station it cost $81.90 per day. To operate the station and destructor it costs $46.50 per day, or a difference of $12,921 per year, this being 10 per cent. of the cost of the plant. This is expected to provide for repairs and amortization charges. Besides, the city has all of its refuse disposed of without cost at a central point and in a sanitary manner with freedom from nuisance. The clinker is used for road building and is estimated to have a value equal to the cost of hauling it from the plant.

All reports agree that destructors are very successful from a sanitary standpoint and have the advantage over other methods in that the different classes of waste can be destroyed by one process and gathered in one collection. Several also agree that the destructors when properly constructed and operated, may be centrally located, thus reducing the cost of haul. Another point mentioned is that there is some revenue. The disadvantages pointed out by experts are that, if not properly designed and operated, there will be dust and odors, all refuse must be hauled to the plant and expert workmen must be employed.

The cost of operation varies from city to city, and in each city from month to month, depending upon the season of the year, composition of the garbage and climate. Most incinerator companies guarantee to operate their furnaces at full capacity at about 50 cents per ton. Milwaukee operates for about 57 cents per ton. The cost, including maintenance, depreciation and fixed charges, and operating expenses, averages $1.50 to $2.50 and sometimes $3.00 per ton. The State Board of Health of Ohio found in its investigation that incineration cost from $1.97 to $2.50 in Canton, Ohio; $2.00 to $2.66 in Marion; $1.00 to $1.84 in Steuben-

ville; and $2.58 in Zanesville, during a period of several years. These figures include interest, depreciation, maintenance and repair charges.

J. W. Turrentine, of the United States Department of Agriculture, who made a study of garbage disposal plants, says in a Department bulletin that the average net cost of incineration per ton as obtained in a number of instances is $2.11 per ton, and that in one of the cities considered there is a credit for power generated of 22 cents per ton of garbage incinerated.

Most garbage incinerator manufacturers claim a life of 20 years for their plants with reasonable renewals.

Morse figures that when fuel is necessary the cost of destroying refuse and garbage in crematories is approximately 50 cents per ton. He also says that the cost of operating destructors is from 50 cents to 70 cents per ton for actual labor expenses, while the cost of operating the modern high-temperature destructor will not exceed from 50 cents to 60 cents per ton. Deducting credit for power, the cost will drop, he says, to 30 cents or less per ton. Depreciation and capital expenses are not included in Morse's calculations.

Greeley asserts that the cost of operation will range from about $1.00 to $1.50 per ton, "but local conditions may alter these limits."

C. O. Bartlett, sanitary engineer, says: "So far as disposal of garbage is concerned, in incinerators, it is coming to be generally understood that this method is far from sanitary and is essentially wrong in that it neglects to obtain the value for the products so collected."

Rudolph Herring, Sanitary Expert, says: "In incineration, if sufficient fuel is added, the combustion can be made perfect and the garbage can be destroyed without offense and converted into unodorous gases, ashes and clinker. Whatever sanitary objection has been made to this process has resulted from preventable causes. Unless ashes and

rubbish are combined with garbage in sufficient quantities to produce the necessary heat, the steam production is deficient and other fuel must be added."

Robert H. Wylde favors incineration at a high temperature: "Here we have a method that is at once sanitary, expeditious and economical in first cost and maintenance." He also says that this method is free from nuisance, the plant may be centrally located, cost of collection minimized owing to the relative shortness of hauls, not necessary to maintain a separate collection, nor is there any necessity to keep refuse in separate cans.

W. F. Goodrich, Sanitary Expert, maintains that modern destructors are perfectly satisfactory and that there may be no fear of nuisance wherever they are located. He maintains that it should be the aim of officials to utilize the power produced for the best interests of the community.

William M. Venable believes that cities of from 10,000 to 40,000 population should burn garbage and refuse, the problem to be solved being the advisability of attempting to utilize the heat generated by burning.

Reduction

When the reduction method is used only garbage and dead animals can be destroyed, but when these kinds of wastes are broken down by means of heat, valuable by-products are recovered. This may be done in two ways, the processes being known as cooking, or digestor system, and drying. In the first, garbage is cooked in large closed retorts by means of steam under pressure. It is then pressed, leaving grease and a dry cake known as tankage, which is used for fertilizer. In the drying method the grease is extracted by some volatile solvent like naphtha. The relative advantages of these two methods is disputed. At the present time the majority of plants are operated by the cooking or digestor method.

Within the last year or two a new reduction process has

been evolved. The raw garbage is placed in sealed, air-tight tanks with jacketed walls and bottom. The solvent is pumped into the reducer and steam admitted to the jacketed walls. The heat causes the evaporation of the solvent and the water in the garbage. When the garbage has been dried, the solvent is pumped into the reducer and dissolves the grease. In an evaporator the solvent is vaporized and carried to a condenser where it is again liquefied and then conveyed to storage tanks. After the extraction of the grease, the garbage is further dried by steam, and as tankage, is used for fertilizer. The chief advantage claimed for this system is that it is odorless. The cost of plant operation is much greater than that of the digestor system, but the value of the recovered products is considerably greater. Plants of this type are being operated in Los Angeles, Cal., and in New Bedford, Mass. The plant now being constructed for handling the garbage of New York City will also employ this new process.

C. O. Bartlett, Sanitary Expert, says that the cooking method does not permit of the recovery of any considerable portion of grease, but does provide for the retention of most of the solids in dry form, after which they may be ground up to serve as a base for fertilizers. He also says that it is open to some objection on account of escaping gases from the stack unless there are sufficient scrubbers.

Irwin S. Osborn, sanitary engineer, sums up as follows the advantages and disadvantages of each process:

Drying Process

Advantages.—Cost of plant is less, due to equipment and space required; the operating costs are less, due to amount of labor and power required.

Disadvantage.—Carbonizing of the grease in the dryer, due to high temperature required, so that the maximum amount of grease is not recovered; the material is not broken down so that solvent will act as readily on grease particles to

allow maximum recovery; the mechanical condition of by-products is not as desirable without additional treatment; there is a greater volume of gases to be deodorized.

Cooking Process

Advantages.—The cells of the material are more completely broken down so that a larger amount of grease can be more readily recovered; all material is enclosed during the process so that the gases are more readily deodorized with less volume to be deodorized; in the modern plants the mechanical condition of the by-products is better.

Disadvantages.—Increased fixed cost of building and equipment; increased operating cost; increased maintenance cost.

Osborn believes that by-products produced by either method have the same relative market value. In plants that have been operated by both methods, the experience has been that the additional amount of grease recovered by the cooking method has more than offset the increased costs and at the same time the odors were eliminated to a larger extent.

In establishing a reduction plant, Rudolph Herring says that the great fear is creating a nuisance. He further asserts that, owing to unpleasant odors apt to arise at the works, it is necessary to have good ventilation and also a subsequent treatment of some of the vapors and liquids which result from the process. These contingencies make it advisable, he thinks, to locate the plant in a neighborhood where the possibility of occasional unpleasant odors will not materially injure value of adjoining property.

The Chicago Waste Commission gives this suggestion as a solution of the odor problem: "In addition to the steam and electrical power that can be furnished from a destructor plant to operate a reduction plant, the exhausting of all gases carrying odors from the reduction works and passing them through the destructor would prove one of the great-

est advantages from a sanitary and economical standpoint to be derived from a combined method of disposal of all municipal wastes."

Osborn says: "Economical results may be obtained by utilization of heat in the disposal of garbage mixed with other refuse, by burning, but to prove satisfactory the maximum sanitary results must be obtained at a minimum cost, and when the quantity is such that it will warrant utilization the reduction method will continue to show more economical results, and with proper attention given to details and sanitary features the work can be conducted without nuisance."

Reduction is a method which can be adopted only by large cities. It seems to be usually agreed that cities with less than 100,000 population and producing less than 75 tons of garbage daily will find the reduction process will not pay as a business venture. One writer says in no place of less than 150,000 population can these kind of plants be operated successfully. Venable places the minimum population at 100,000. He says that as approximately 80 per cent. to 90 per cent. of kitchen garbage is water and only 10 per cent. to 20 per cent. is composed of grease and other substances it takes a large amount of garbage to make reduction plants profitable.

The cost of a reduction plant will range from $1,500 to $3,000 per ton daily capacity, according to published reports.

The gross cost of garbage destruction by the reduction method varies from $1.50 to $2.50 per ton of raw garbage. In only a few instances does the sale of the by-products meet or exceed expenses. In a majority of cases, the process is carried on by private companies, the most being subsidized by cities to amounts varying from 50 cents to $2.50 per ton. A few companies pay the city for all garbage delivered to the plant.

The by-products of the reduction method are grease and tankage. It is generally agreed that ordinary garbage

contains from 2 per cent. to 3 per cent. by weight of grease and must yield from 200 to 400 pounds of tankage per ton.

'Columbus, Ohio, has been conducting experiments in making alcohol from green garbage and its reports indicate that cities having reduction plants may produce another by-product from their waste. The experiments were carried on for some time under the direction of the assistant superintendent in cooperation with Dr. James J. Morgan, a Chicago chemist who has patented a process of distilling the alcohol from chemically-treated garbage. It requires only a slight addition to the present processes of the plant. The garbage is treated with a two per cent. solution of sulphuric acid for cooking, then with lime and finally with yeast for fermentation. The claim is made that the amount of grease and tankage is not reduced by the process, and it is estimated that every ton of garbage will yield about six gallons of alcohol. The superintendent of the Division of Garbage and Refuse Disposal in November, 1917, informed the New York State Bureau of Municipal Information that the final report on the experiment "was favorable to the process, but our city council did not see fit to authorize the installation of the necessary equipment for the process."/

J. W. Turrentine says that on a basis of figures obtained in the operation of a number of reduction plants, it is shown that the average cost of reduction is $2.41 per ton, and the gross receipts $3.30 per ton, giving a profit of 89 cents per ton raw garbage. He asserts that when consideration of cost of collection is excluded, the rendering of garbage is distinctly more profitable than incineration.

Cleveland and Columbus have been the cities most successful in operating municipal reduction plants. In one year the Columbus plant received 21,628.97 tons of garbage, or 211 pounds of garbage per capita. From this and the 183 large dead animals received, the actual production was as follows: Grease, 1,186,985 pounds; tankage, 1,753 tons; hides, 183. The value of these by-products were: Grease,

$57,672.21; tankage, $12,987.84; hides, $1,062.30, or a total of $66,772.35.

Each ton of garbage produced 54.87 pounds of grease and 162.1 pounds of tankage. The grease value per ton of garbage was $2,435; the tankage, 60 cents, and the hides 5 cents, or a total of $3,085 per ton of garbage. The actual cost of operation was $40,220.78 or $1,859 per ton. The net profits were $26,502.57 or $1.226 per ton of garbage.

Cleveland in one year produced 2,940,000 pounds of grease and 10,016,000 pounds of tankage, the city receiving for them $151,162.48. This reduction cost per ton of green garbage was $1.97½ and the earnings per ton of green garbage was $3.47, making the net earnings per ton of garbage $1.49½.

New York City is selling its garbage to a private company. It made a contract for 1914 to 1916, inclusive, and the right to renew the contract for two more years on the same terms and conditions. The city receives at the rate of $62,500 for the first, $87,500 for the second, and $112,500 for the third and each of the succeeding two years. Plans are now being made to operate a municipal plant.

TABLE VII

METHODS AND COST OF DISPOSING OF GARBAGE

Table

METHODS AND COST OF

Name	Method of Disposal	By Whom Done	City Own Dump? If Not, Annual Rental	City Own Farm and Hogs?	Is farm Rented by City?	Kind of Plant	Capacity	When Built
New York City[b]	Reduction.	Contract. Building municipal plant.	.....	.....	....	Reduction.	2,000 tons	1896
Buffalo	Dumping and Incineration.	Contract.	Some of them.	.....	....	Incineration.	40 tons.	1903
Rochester	Reduction.	Contract. City has decided to own its plant.	.....	.....	....	Reduction.	.....	1907
Albany	Fed to pigs.	Contract.	.....	No.	No.	.....	.....	....
Binghamton	Feeding and burning.	Private sanitary companies.	.....	No.	No.	.....	.....	....
Schenectady	Reduction.	City.	.....	.....	....	Reduction.	30 tons.	1914
Syracuse	Reduction.	Contract, planning municipal operation.	.....	.....	....	.....	.....	....
Troy	Dumping.	Contract.	$12,000	.....	....	.....	.....	....
Yonkers	Incineration.	City.	.....	.....	....	Incineration.	9 tons.	1839
Utica	Reduction.	Contract.	.....	.....	....	Reduction.	.....	....
New Rochelle	Incineration	.....	.....	.....	....	.....	.....	1917
Watertown	Feeding to pigs.	.....	.....	No.	No.	.....	.....	....
Auburn	Dumping and ploughing under.	.....	.....	.....	....	.....	.....	....
Beacon	Dumping for fill.	.....	No. No rental.	.....	....	.....	.....	....
Mechanicville	Dumping for fill.	Contract.	No. No rental.	.....	....	.....	.....	....
Dunkirk	Feeding and ploughing under.	.....	No.	No.	No.	.....	.....	....
Saratoga	Dumping.	.....	$50 per yr.	.....	....	.....	.....	....
Middletown	Dumping for fill.	.....	No.	.....	....	.....	.....	....
Kingston	Dumping.	.....	No.	.....	....	.....	.....	....
Jamestown	Ploughing under.	Contract.	No.	.....	....	.....	.....	....
Fulton	Dumping for fill.	.....	Yes.	.....	....	.....	.....	....
Port Jervis	Dumping.	Contract.	No.	.....	....	.....	.....	....
Elmira	Incineration and dumping.	Dumping only by city.	No. $300.	.....	....	Incineration.	Uses about half city garbage.	1906
Salamanca	Dumping.	City.	.....	.....	....	.....	.....	....
Rome	Dumping.	.....	.....	.....	....	.....	.....	....
Niagara Falls	Dumping in river.	.....	.....	.....	....	.....	.....	....
Cortland	Dumping.	Contract.	No.	.....	....	.....	.....	....
Cohoes	Dumping.	.....	Owned by contractor.	.....	....	.....	.....	....
Plattsburgh	Dumping on land and in water.	.....	One dump.	.....	....	.....	.....	....
Ithaca	Dumping for fill.	City.	Some. No rental.	.....	....	.....	.....	....
Olean	Feeding to hogs.	.....	.....	No.	No.	.....	.....	....
Johnstown	Dumping.	.....	No. $100 per year.	.....	....	.....	.....	....
Ogdensburg	Dumping.	.....	.....	.....	....	.....	.....	....
Gloversville	Dumping.	Contract.	Yes.	.....	....	.....	.....	....
Hudson	Feeding to hogs.	Contract.	No.	No.	No.	.....	.....	....
Little Falls	Feeding to hogs.	Contract.	.....	No.	No.	.....	.....	....
North Tonawanda	Ploughed under.	Contract.	No. No rental.	.....	....	.....	.....	....
Newburgh	Feeding and ploughing under.	Contract.	.....	No.	No.	.....	.....	....
Norwich	Dumping.	.....	No. $50.	.....	....	.....	.....	....
Mount Vernon	Feeding and dumping for fill.	Contract.	Contractor rents it.	No.	No.	.....	.....	....
Lockport	Feeding and dumping.	City.	Yes.	No.	No.	.....	.....	....
Hornell	Feeding and ploughing under.	City.	No. $50.	No.	No.	.....	.....	....
Rensselaer	Feeding and dumping.	City.	Yes.	No.	No.	.....	.....	....
Batavia	Dumping and feeding.	City.	Yes.	No.	No.	.....	.....	....
Tonawanda	Feeding and dumping.	Contract.	No.	No.	No.	.....	.....	....
Corning	Feeding to hogs.	Contract.	Contractor owns farm.	No.	No.	.....	.....	....
Oswego	Dumping on land.	.....	.....	.....	....	.....	.....	....

VII

DISPOSING OF GARBAGE

Design	Any Odor?	Annual Cost of Operation	By-Products	What is Done with By-Products	Annual Revenue from By-Products	Net Cost of Disposal*		Net Profit
						Per Ton	Year	
Arnold.	.....	.....	Grease and tankage.	.....	.....	.....	.....	$112,500 a yr.
Heenan-Froude.	.....	.....	.....	.....	.....	$1.25	.....	.....
Genesee Reduction Co.	.....	.....	Grease and tankage.	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....
Chamberlain	Yes.	$27,000.00	Tankage and grease.	Sold.	$3,000.00	10.23	$34,200.00	.....
.....	At times.	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....
N. Y. Garbage Crematory.	No.	3,380.50	.....	.....	.....	1.40	3,880.50	.....
.....	Very little.	.....	Grease.	Sold for soap, residue used for fuel.	.....	.....	4,100.00	.....
Morse-Boulger	.....	.....	.....	.....	.....	.....	.....	.....
.....

Table VII

METHODS AND COST OF

Name	Method of Disposal	By Whom Done	City Own Dump? If Not, Annual Rental	City Own Farm and Hogs?	Is Farm Rented by City?	Kind of Plant	Capacity	When Built
Canandaigua	Feeding to hogs.	Private company.	.....	No.	No.	.....	.....	....
Borough of Queens	Crematories, dumping and reduction.	Crematories and dumps by city. Reduction by contract.	No.	.....	....	3 crematories.	30 tons.s	1909
Amsterdam	Incineration.	City.	.....	.....	....	.....	.....	....
Poughkeepsie	Dumping.	City.	No.	.....	....	.....	.....	....
Atlanta, Ga	Incineration.	Contract.	.....	.....	....	Incineration.	250 tons.	1913
Columbus, Ohio	Reduction.	City.	.....	.....	....	Reduction.	200 tons.	1910
Cincinnati, O	Reduction.	Contract.	.....	.....	....	Reduction.	.....	....
Milwaukee, Wis	Incineration.	City.	.....	.....	....	Incineration.	300 tons.	1910
Detroit, Mich	Reduction.	Contract.	.....	.....	....	Reduction.	.....	....
Washington, D. C.	Reduction.	Contract.	.....	.....	....	Reduction.	.....	1900
St. Louis, Mo	Reduction.	Contract.	.....	.....	....	Reduction.	400 tons.	1913
Lawrence, Mass	Feeding to pigs.	.....	.....	Two loads daily sent to Poor Farm. Rest sold.	....	.....	.....	....
New Orleans, La	Dumping for fill.	City.	Yes.	.....	....	.....	.....	....
Hartford, Conn	Feeding to pigs and burned.	City.	Yes.	No.	....	.....	.....	....
Baltimore, Md	Reduction.	Contract.	.....	.....	....	.....	.....	....
Bridgeport, Conn	Reduction.	Contract.	.....	.....	....	Reduction.	60 tons.	1910
Cleveland, O	Reduction.	City.	.....	.....	....	Reduction.	300 tons.	1905
Lowell, Mass	Fed to pigs.	.....	.....	.....	....	.....	.....	....
Cambridge, Mass	Fed to pigs.	.....	.....	.....	....	.....	.....	....
Louisville, Ky	Dumping.	.....	No.	.....	....	.....	.....	....
Pittsburgh, Pa	Reduction.	Contract.	.....	.....	....	Reduction.	.....	....
Denver, Col	Fed to hogs.	Contract.	.....	No.	....	.....	.....	....
Savannah, Ga	Incineration.	City.	.....	.....	....	Incineration.	130 tons.	1914
Chicago, Ill	Reduction and incineration.	City.	.....	.....	....	Reduction.	900 tons.	1913
Kansas City, Mo	Fed to pigs.	Contract.	.....	No.	....	.....	.....	....
Boston, Mass	Reduction.	Contract.	.....	.....	....	Reduction.	.....	....
Lynn, Mass	Fed to pigs.	.....	.....	.....	....	.....	.....	....
Grand Rapids, Mich.	Fed to pigs.	.....	.....	No.	....	.....	.....	....
Minneapolis, Minn.	Incineration.	City.	.....	.....	....	Incineration.	.....	1905
St. Paul, Minn	Fed to hogs.	.....	.....	No.	....	.....	.....	....
Jersey City, N. J	Dumping for fill.	Contract.	.....	.....	....	.....	.....	....
Passaic, N. J	Burial.	.....	.....	.....	....	.....	.....	....
Paterson, N. J	Incineration.	City.	.....	.....	....	Incineration.	60 tons.	1912
Trenton, N. J	Incineration.	City.	.....	.....	....	Incineration.	65 tons.	1901
Dayton, O	Reduction.	City.	.....	.....	....	Reduction.	125 tons.	1915
Providence, R. I.	Fed to pigs.	.....	.....	No.	....	.....	.....	....
Charleston, S. C	Dumping.	.....	.....	.....	....	.....	.....	....
Nashville, Tenn	Feeding to hogs.	.....	.....	.....	....	.....	.....	....
Seattle, Wash	Dumping for fill.	City.	.....	.....	....	.....	.....	....
Spokane, Wash	Incineration.	City.	.....	.....	....	Incineration.	120 tons.	1908
Oakland, Cal	Dumping in ocean and incineration.	Contract.	.....	.....	....	Incineration.	100 tons.	1907
New Bedford, Mass.	Reduction.	Contract.	.....	.....	....	Reduction.	30 tons.	1905
Springfield, Mass	Reduction.	Contract.	.....	.....	....	Reduction.	75 tons.	1913
Portland, Ore	Incineration.	City.	.....	.....	....	Incineration.	150 tons.	1910
Philadelphia, Pa	Reduction and feeding to pigs.	Contract.	.....	.....	....	Reduction.	500 tons.	....
Scranton, Pa	Incineration.	City.	.....	.....	....	Incineration.	80 tons.	....
Reading, Pa	Incineration.	City.	.....	.....	....	Incineration.	100 tons.	1914
Richmond, Va	Incineration.	City.	.....	.....	....	Incineration.	100 tons.	1910
Los Angeles, Cal.	Reduction and feeding to pigs.	Contract.	.....	.....	....	Reduction.	300 tons.	1915
San Francisco, Cal.	Reduction.	Contract.	.....	.....	....	Reduction.	750 tons.	1897

(Continued)

DISPOSING OF GARBAGE

Design	Any Odor?	Annual Cost of Operation	By-Products	What is Done with By-Products	Annual Revenue from By Products	Net Cost of Disposal*		Net Profit
						Per Ton	Year	
.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.161 cu. yd.y	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....
Destructor Co.	None from operation.	25c per ton	Cinders.	Dumped.	None.	*f*	*f*	*f*
.....	Slight.	$1.86	Grease, tankage, hides.	Sold.	$66,772.35	.....	.....	$1.226 per ton
.....	.....	.....	.....	.....	.....	.....	.....	.....
Heenan-Froude.	Not 50 feet outside wall	$68,892.45	Electric power.	Operates pumping station.	$10,000.00	$1.26*g*	.....	.....
Detroit Reduction Co.	.....	.....	.....	.....	.....	City pays	nothing.	.....
Arnold.	40 miles from city.	.....	Grease and tankage.	Sold.	.....	$2.31*h*	.....	$1.89 per ton*j*
.....	Occasionally	.....	Grease and tankage.	Sold.	.....	.87*k*	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	$1.25 a load.
.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	$68,000.00*m*	.....
.....	Occasionally.	.....	.....	.....	.....	.50*m*	.....	.....
Newburgh Reduction Co.	Very little.	$132,890.00	Grease and tankage.	Sold.	$195,000.00	.....	.....	$1.49½ per ton
.....	.....	.....	.....	.....	.....	.....	.....	$5,919.77
.....	.....	.....	.....	.....	.....	.....	.....	$15,000.00*n*
.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	Yes.	.....	.....	.....	.....	$2.25	$290,000.00	.....
.....	.....	.....	.....	.....	.....	Free.	.....	.....
Heenan-Froude.	No.	.615c	Steam and clinker.	Used on roads.	.....	.86	.....	.....
Arnold.	Very little.	.....	Dried garbage.	Sold.	.....	.....	$144,744.00	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	$925,318.56*p*	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	45c per ton.
Decarie.	No.	.....	Power.	Heats buildings, lights buildings and streets.	$27,000.00	.85	$16,000.00	.....
.....	.....	.....	.....	.....	.....	.....	.....	80c per ton.
.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....
Destruction Co.	No.	.....	.....	None.	.....	.877*r*	$9,527.42	$1.18
Davis.	No.	.....	Only ashes.	None.	.....	.48*s*	$7,106.37*s*	.....
.....	Slight.	.....	Grease and tankage.	Sold.	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....
Decarie.	No.	.....	Ashes.	Sold.	$5.00	.60	.....	.....
Decarie.	.....	.....	.....	.....	.....	.60	.....	.....
.....	No.	.....	.....	.....	.....	.....	$25,500.00	.....
	Some.	.....	.....	.....	.....	*t*	*t*	*t*
F. P. Smith.	No.	.....	.....	.....	34c per ton.	.34*u*	.....	.....
.....	Yes.	.....	Grease and tankage.	.....	.....	.....	.....	.....
Lewis & Kitchen Co.	No,	.28	Ashes.	Sold.	.....	.....	.....	.....
Morse, Boulger & Decarie.	No.	.....	.....	.....	.....	$1.00*w*	.....	.....
.....	No.	.....	Grease and tankage.	.....	.....	.....	.....	51c per ton for reduction, $1 for feeding.
Chas. Thackery patents.	Much.	.....	None.	.....	.....	.60*x*	.....	.....

Table VII

METHODS AND COST OF

Name	Method of Disposal	By Whom Done	City Own Dump? If Not, Annual Rental	City Own Farm and Hogs?	Is Farm Rented by City?	Kind of Plant	Capacity	When Built
Newark, N. J.	Reduction.	Contract.	.....	.....	....	.....	.....	....
Indianapolis, Ind.	Reduction.	Contract.	.....	.....	....	.....	.....	....
Toledo, O.	.....	.....	.....	.....	....	.....	.....	....
Worcester, Mass.	Feeding to pigs.	City.	.....	Yes.	No.	.....	.....	....
New Haven, Conn.	Feeding to pigs and composting.	.....	.....	Yes.	....	.....	.....	....
Birmingham, Ala.	Dumping on land.	City.	.....	.....	....	.....	.....	....
Memphis, Tenn.	Incineration and dumps.	City.	Yes.	.....	....	Incineration.	50 tons.	....
Omaha, Neb.	Feeding to pigs.	.....	.....	No.	....	.....	.....	....
Fall River, Mass.	Feeding to pigs.	Contract.	.....	No.	....	.....	.....	....

Glens Falls and Oneonta, N. Y., report that they have no systems.

* Includes interest, depreciation, maintenance and repair charges. *a* Collection and disposal. *b* Manhattan, Bronx and Brooklyn Boroughs only. *c* No cost for superintendence, man receiving salable rubbish for his pay. *d* Guaranteed. *f* Plant not yet under control of city, court action pending. *g* Labor and supply. *h* Gross. *j* Estimated. *k* Contract price.

(Continued)

DISPOSING OF GARBAGE

Design	Any Odor?	Annual Cost of Operation	By-Products	What is Done with By-Products	Annual Revenue from By-Products	Net Cost of Disposal*		Net Profit
						Per Ton	Year	
.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	Manure and hogs.	Sold.	$38,838.67	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	Yes, at times.	30c to 40c	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	No expense.	.....	.....

m Price paid by city. *n* City sells for 70c per cord ft. *p* Includes collection. *r* Labor only. *s* Does not include interest and depreciation. *v* City may buy plant at end of ten years for $50,000, at end of twenty years it becomes property of city free of cost. *w* Fuel and wages. *x* Price paid reduction company by scavengers. *z* Eight-hour capacity. *y* Includes maintenance and repair charges, and is for crematories only.

CARE AND DISPOSAL OF MANURE

CARE AND DISPOSAL OF MANURE

REGULATIONS IN MANY AMERICAN CITIES—PROVISIONS FOR STORING AND REMOVING THE WASTE—CARE OF STABLES

SOME cities have made very stringent regulations for the care, collection and disposal of stable manure within their limits; others are not so exacting and many have not as yet given any thought to the subject, or if they have no municipal laws have been enacted. The importance of municipal regulation is recognized by all sanitarians, and especially since the house fly has been regarded as one of the chief spreaders of disease. If for no other reason than to eliminate the greatest breeding place of the fly, stable manure should be properly cared for, and stables and other places where animals are kept in cities should be clean.

The regulations of most cities require the individual to dispose of the manure on the premises he owns or occupies. Only a few cities have a municipal collection system or have the work done under contract. In those cities where gardeners and farmers are permittted to collect the waste voluntarily no trouble has been experienced during the winter months when the farmer is not busy on the soil, but during the spring and summer, when the need of cleanliness is greatest, but when the farmer is too busy planting and harvesting, the collection is neglected. Minneapolis is one of the cities which have suffered in this way. In several cities one or more companies deal in manure, maintaining wagons exclusively for collection purposes. The manure is carted either to the railroad direct for shipment or to persons purchasing it. In most instances these companies pay a small amount for the manure. The stable manure in Washing-

ton is collected and disposed of in this manner. Toronto, Canada, contracts with four different companies to remove the manure. These make a nominal charge for the collection, the city being under no expense. In Jersey City the waste is carted away by private contractors and most of it is sold to farmers. Denver transfers its stable manure to the city dump where it is hid during the summer months and in the spring is sold to gardeners. The city sanitary inspector does not regard this plan as satisfactory.

There seems to be an unanimity of opinion among most municipal sanitarians that the city itself should be prepared to remove manure when owners or occupants fail or refuse to do so. Every owner should be allowed to sell it if he can; otherwise, it should be regarded as a nuisance, and the city should remove it without compensating the owner, but charging him for the service. Unquestionably as cities continue to grow and as congestion becomes greater such a plan will be adopted by most municipalities.

One of the best systems in operation is that in Columbus, Ohio, where manure is collected by municipal employees from any stable within the city limits. The Columbus ordinance provides that any person desiring to have the manure removed must take out a permit for such service at a yearly charge of $3 for one horse, $5 for two horses and $1 for each additional horse. After the ordinance became a law the Department of Public Safety began to notify the public that from and after April 1, 1912, no manure would be removed without the payment of a fee.

Between September 1 and June 1 the demand for manure is greatly in excess of the supply and the city could sell three or four times as much as it collects. During the remainder of the year there is practically no demand for the waste as farmers cannot handle it.

The collection is made under the following rules: Whenever a person pays to the city treasury the ordinance charge for manure collection the Department of Public Service is

notified on a blank form. The name, address, permit number, and number of horses are recorded in alphabetical order. To each of the four drivers employed in collection is given a separate list of barns from which to collect, and each evening he reports the places from which he made collection during the day.

Following is a detailed statement of the cost of collection and the receipts from the sale of manure for 1916 when prices were normal:

Total number of loads hauled	1486
" " " tons collected	2972
Expenses	
Teams and labor	$2,689.25
Superintendent, inspection, etc	200.21
Repairs, etc	546.49
Receipts	
Sale of manure	$2,029.50
Receipts from citizens for collection	672.00
Cash on hand	15.00
Open account on books for year	148.00
Net cost	739.90
Cost of collection per load	2.31
" " " " " less receipts	.49
" " " " ton " "	.24½

The Civil Engineer of the Columbus Health Department says that a market has been found for the entire output of the city, the prevailing price being $2 a wagon load delivered anywhere inside the city limits, and for shipment $15 per average car f. o. b. cars, city loading station. He further says that about 15 per cent. of the manure produced in Columbus, a city of 200,000 inhabitants, is collected. "It seems," he says, "perfectly possible to collect all manure produced in the city at a very low cost to the municipality, for during the year 1913 only three 2-ton wagons were used

in manure collection and they proved to be sufficient to handle the work with ease."

In Chicago manure must be removed every seventy-two hours and collected by licensed scavengers at the expense of the stable owner. Only during the last two or three years was specific authority over stables granted to the Health Department, which immediately began an inspection of all stables. Of the first 500 inspected it was found that from a sanitary standpoint they were in very poor condition.

An example of stringent regulations in a large city is the ordinance adopted by New York City. It follows:

"No manure vault, pit or bin shall be allowed upon the premises used for stabling purposes, except upon premises used for barning in unimproved sections of the city. All manure and stable refuse shall be kept within the stable and removed daily, or if not removed daily shall be pressed into bales or barrels adequately screened or otherwise protected or covered so that flies cannot have access thereto, or otherwise treated as approved by the Department of Health. All such manure or stable refuse so baled, barreled or treated, shall be removed from stables at least twice weekly.

"The loading of manure for removal shall be done within the stable without causing a nuisance.

"No person shall engage in the business of transporting manure or drive any cart for that purpose, in the City of New York, without a permit therefor issued by the Board of Health or otherwise than in accordance with the terms of said permit and with the regulations of said board.

"The permit issued by the Board of Health shall be securely fastened in a conspicuous place, on the right side near the front of the vehicle used in the transportation of offensive materials. Vehicles used in the transportation of offensive materials while loaded, either wholly or in part, shall not remain on the street or place any unreasonable length of time, and shall not, except when unavoidable, stop

in front of any premises other than those from which material is being collected.

"All vehicles and contents therein shall be thoroughly cleaned upon the completion of a day's use, and so stored as not to cause a nuisance.

"Manure may be transported to a dump operated under a permit issued by the Department of Health or to firms in the unimproved sections of the city, or to points outside the city of New York. Every vehicle used in transporting manure shall be tight and provided with a suitable cover so as to prevent the dropping of manure upon the streets; if the cover be of canvas or of other similar material, it shall be of sufficient size completely to cover the manure within the vehicle and shall be securely fastened on all sides of the vehicle.

"No vehicle engaged in the transportation of manure shall be permitted to load upon the sidewalk, in the alleyway, in the yard or any place except the stable."

For a small city the ordinance of Newburgh, New York, contains several good suggestions. It is as follows:

"All stables, barns and other places wherein horses or cattle are kept, shall be kept in a clean and sanitary condition. All accumulations of manure shall be stored in such places and be removed with such frequency and in such manner as to prevent offensive and noxious odors. Not more than two loads of horse or cow manure shall be allowed to accumulate on any premises within the city limits and no piles of manure shall be allowed to accumulate in any position or manner whereby they shall become breeding places of flies or whereby any leachings therefrom may pass into any stream or water course. Any violation of this ordinance shall subject the offending party to a penalty of not more than $50 for each offense and for each day's continuance or repetition of the offense.

"No manure or stable refuse shall be deposited within any building or the cellar thereof unless said receptacle shall be

enclosed by eight-inch brick, cement or concrete walls, all of which shall be waterproofed on sides and have cement waterproof floors, and connected with public sewers by suitable tile pipes properly trapped and with suitable fall to carry off all liquid, said outlet to be covered with fine grating or screen, top of said pit or receptacle to be covered with a tight cover and to have a brick, cement, concrete or galvanized iron flue, at least eight inches in diameter, and to be airtight and to extend to the top or cover of said receptacle or pit up to and through the roof, and at least three feet above said roof and above the roof of any adjoining buildings, access to said pit to be by door hung on suitable hinges and to be kept closed and fastened except when refuse is being deposited in or removed from the same; in no case shall said receptacle be constructed within any building where no connection can be made with public sewers. All receptacles for manure or stable refuse that are constructed outside of any building shall be commenced at least twelve inches below the lowest grade of the land adjoining same and shall be waterproof on both sides and covered with suitable cover properly hinged and to be kept closed except when depositing therein or removing manure or refuse therefrom; the sides of said pit may be constructed of matched plank and as directed by the health officer; all of the above construction must be so done as to make same inaccessible to flies."

Exceptional regulations have been noted in the following cities: Aberdeen, Washington, does not allow a bin or receptacle to be built nearer to an adjoining house than 25 feet. Manure for agricultural or garden purposes must be thoroughly mixed and covered with soil so as not to attract flies. Bayonne, New Jersey, will not allow any pit nearer than 10 feet to the line of any adjoining lot, alley or public place. Truck gardeners must secure a permit to store manure, and the waste cannot be carted through the streets between 7 a. m. and 6 p. m. without a permit. Manure can-

not be unloaded, discharged or put upon or along the line of any railroad (except in transit), street or highway. A permit must be secured for cars containing manure to remain on or stand on or along any railroad, street or highway. In Cincinnati disinfectants must be used about those portions of the floor where manure and urine habitually fall or are maintained. Manure stacked for fertilizer on a truck farm must be at least 50 feet from any dwelling and shall be stored in a closed bin or screened receptacle in order to prevent access of flies thereto.

Los Angeles requires a permit from its Health Commissioner for piling manure for fertilization, the permit to designate the place and amount that may be kept. Manure cannot be scattered even if covered in Mankato, Minnesota, except for fertilization or the "protection of plants, shrubs, houses or buildings in winter months."

North Yakima, Washington, requires that manure used as fertilizer from May 15 to October 15 must be mixed and covered with soil. It cannot be used as grading.

In Oyster Bay, New York, no manure is allowed to be brought in or unloaded or placed on any dock or landing from June 1 to September 1. All manure brought into town must be entirely removed by June 15. All brought in by rail must be unloaded within 250 feet of any station. Several cities provide that all collections or accumulations of any hennery park, stable refuse or manure in or about any hennery park, barn, stable, yard or appurtenance thereof must be removed before the same shall become offensive. Dumping of manure in any river, canal, stream or pond is prohibited in Little Falls, New York. Every person keeping a stable for horses, mules, cows or similar animals in Poughkeepsie, New York, must report his name and the location of the stable to the Health Officer.

There is no general uniformity of regulations as to how often manure shall be removed. In some cities the ordinances are specific, in others the refuse must be removed

when ordered by the Board of Health, and in many it must be carted away before it becomes offensive. Some of the various regulations follow: Aberdeen, Washington, every 30 days from April 1 to November 1, and oftener if the Health Officer directs; Bayonne, New Jersey, once a week in all cases where the Board of Health by written notice shall require; Chattanooga, Tennessee, once a week; Cincinnati, Ohio, once a day and disposed of to the satisfaction of the Health Department; Des Moines, Iowa, twice weekly from March 15 to December 1 and once a week thereafter; Erie, Pennsylvania, accumulation of only one wagon load from May 1 to October 1 in any private stable, and two loads in any private or livery stable without permission of Board of Health; Greenfield, Mass., where more than four horses are kept it must be removed at least once a month and no more than five cords are allowed on premises at any one time; Los Angeles, California, every ten days when kept in bins and every day otherwise; Mankato, Minnesota, as often as necessary and when ordered by the Board of Health.

Every city and town should regulate at least the care of manure and in congested communities it is imperative that the city either provide a municipal collection or make provisions whereby the refuse can be removed under contract. Any community which fails to do this continues a nuisance and fails to check the breeding of flies and the possible spreading of disease.

MUNICIPAL CLEAN-UP CAMPAIGNS

MUNICIPAL CLEAN-UP CAMPAIGNS

INTENSIVE COMMUNITY EFFORTS TO TEACH URBAN RESIDENTS THE NEED OF CLEANLINESS AND FIRE PREVENTION

COOPERATIVE effort to give the municipality a thorough cleaning at least once a year, and, by so doing, to teach the citizen the importance of continuous cleanliness in and about his home, has been undertaken within the last ten years by most American cities. These intensive community efforts are popularly known as clean-up campaigns.

At first the clean-up campaign, lasting a day or two, was devoted to ridding homes and yards of rubbish and waste that had accumulated during the winter months. Later the campaigns were spread over a week or a longer period, and now not only is an effort made to collect and cart away the winter's accumulation of waste, but the city also undertakes to educate its citizens in fire prevention work, fly and mosquito extermination, the beautifying of homes and yards, and the elimination of every unsanitary condition. Cellars, garrets, back-yards, vacant lots, alleys, public streets—in fact, every spot in the city, whether on public or private property, does not escape the scrutiny of the public officials and citizens' committees.

The movement spread rapidly until practically every city had at least a spring campaign. Some repeated the effort in the fall. After two or three annual campaigns several municipalities, particularly the larger ones, thought that instead of making a limited intensive effort to clean house, a continuous campaign should be conducted. The advocates of this plan claimed that any periodical effort had a tendency to make the average citizen clean up only during

the campaign, and that during the rest of the year he lapsed into his usual indifference. Within the last few years, therefore, some cities have abandoned the clean-up campaigns and have made greater efforts during the entire year to rid the community of all unsanitary conditions.

The clean-up campaign, however, has become a permanent municipal activity in America. It has taught the citizen not only his responsibility in and about his home, but also the need for greater activity by governmental agencies to eliminate general unsanitary conditions.

Initiating a Campaign

In order to initiate a clean-up campaign, an agitation for it must first be started. The press, civic organizations and industrial life insurance companies have been the principal agitators.

The industrial life insurance companies reach the individual citizen and endeavor to get his cooperation in the movement for more sanitary laws and conditions. Unlike the press they reach the foreigner and the class of people who do not read the newspapers, or at most only the Sunday editions.

Some idea of the possibility for individual and community good which these agencies hold in their power may be gained when one considers that one company alone has millions of policy holders in the United States and Canada. The collectors making their weekly or monthly calls distribute leaflets and circulars disseminating sound ideas in regard to public and private health.

It is not possible to over-rate the press as a factor in the clean-up movement. The work of the newspaper does not stop with the spreading of information both before and during the campaign—in some instances it takes part in the activities. The columns of the newspapers are open to everything of a news nature that will materially assist—

news stories, special articles, editorials, daily programs, cartoons and advertisements.

While the removal of rubbish is essentially a municipal affair, in many instances it was not until civic organizations, such as chambers of commerce, women's clubs and school clubs, started an agitation for community effort that cities realized their responsibility and inaugurated campaigns.

The Organization

In planning the organization of the campaign, the Mayor usually appoints a Clean-up Week Committee, consisting of one representative each from the Department of Public Works or Street Cleaning, Health and Fire. This committee outlines the plan and scope of the work. Usually the physical work is performed by or under the supervision of the Bureau of Street Cleaning, although in some cities the health officials have had charge of the work. After a plan has been adopted to interest every man, woman and child in the community, a proclamation by the Mayor starts the ball rolling and the campaign is on.

As it is only through local organization that cooperative specific community steps can be taken, an effort is first made to secure district organization. The industrial insurance companies with their already well organized plans on clean-up, baby welfare, health, fly and mosquito campaigns, are important agencies for such steps in most cities. The aid of public school principals, the clergy and others is also sought. Very effective organization is secured also through the help of the various welfare and civic organizations.

The official Clean-Up Week Committee usually appoints a Citizens' Committee, representing the leaders of the financial, educational, business and religious life of the city. The members of this committee offer their time and services free. The Citizens' Committee is subdivided, sometimes into as many as twelve committees, consisting, as in Philadelphia, of finance, press, poster and printed matter, trade associa-

tions, community associations, charitable and benevolent associations, schools and school children, churches, retail stores, street cars, vacant lots and fire prevention.

The following is the plan of organization that has been used by many small cities:

One man and one woman as directors of the general movement.

A committee on public buildings, factories and stores.

A committee on residences and outbuildings.

A committee on streets and alleys.

A committee on parking and planting.

A committee on painting and repair work.

A committee to interest school children.

A committee to supply the teams and remove the rubbish.

Captains for working crews for each day of the campaign.

The plan of Cincinnati is a representative one where the campaign is initiated and carried on by a civic organization with the assistance of public officials.

The President of the Chamber of Commerce of that city suggested it might be worth while to start a clean-up movement, and, accordingly, a number of letters were sent to prominent people informing them of the proposed movement, and asking, if they thought the idea worthy of merit, to meet at the Chamber of Commerce on a certain evening. Thirty-five persons, representatives of organizations and the city government, all enthusiastic over the idea, met as suggested. A committee, consisting of the Superintendent of Schools, Superintendent of Salvage Corps, Executive Secretary of the Chamber, and the Chief of Police, was appointed to plan the organization and name officers and members of committees. This committee submitted a report laying out a plan along the following lines:

1. Organization by districts coextensive with public school districts.

2. These district organizations to be uniform in character as far as possible.
3. The work in each district to be done by the people in that district.
4. General committees, the members to form the General Council in charge of the campaign.
5. An Executive Committee to be composed of the chairmen of the General Committees, and to be in immediate charge of the campaign.
6. The campaign to extend over a number of weeks and to be followed by a general inspection of the buildings of that city.

The report of this Committee, including its selection of the Superintendent of Schools as General Chairman and the Manager of the Civic and Industrial Department of the Chamber of Commerce as General Secretary, was submitted to a large meeting attended by representatives of the civic organizations, the State Fire Marshal, the schools, the Fire Prevention Bureau, the Salvage Corps and others. Its plan of organization was adopted and its selection of members of the committees approved. The Mayor promised the cooperation of all city departments.

Publicity Plans

The keystone in the arch of any successful campaign is effective publicity. This is obtained through newspapers, bulletins, circulars, buttons, rubber stamps, placards, posters, motion pictures, banners, trolley cars, bill boards and private advertising.

Cincinnati reports that no other factor contributed more to the success of its campaign than the newspapers. By giving daily reports of the progress of the work during clean-up week the press created a rivalry among the various wards.

In the Philadelphia campaign the total space devoted to newspaper publicity amounted to 14,225 lines, or 88 full

length columns of printed matter, of one column a day for eleven days in each of the Philadelphia newspapers. For the benefit of the foreign born the same information was printed in every foreign newspaper published in that city. Cartoonists depicted Clean-up Week as a family affair and showed it to be a real pleasure as well as a necessity. The editorial writers in a more serious vein urged the necessity of cooperation and pointed the way to communal benefits to follow.

Bulletins, properly distributed, are effective in arousing civic pride and procuring the cooperation of householders. The first should be the official proclamation by the Mayor. The Mayor of Kirkville, Illinois, gave this advice in his proclamation:

If your store is dingy—paint it.
If your awning is ragged and old, get a new one.
If your walk is an eyesore to those traveling over it, repair it or have a new one.
If there are unsightly traps in front of your property, or broken limbs, burn them.
If in your back yard there are old, tumble-down sheds, tear them down. The ground is too valuable, and such things detract from the beauty of the home—and the town.
Clean out all barnyards and stables at once. Don't give the flies a chance to breed.
Clean out the alleys back of your homes.
Take all rubbish and ashes from your back yard immediately.
By all means do your part to make Kirkville a cleaner and more beautiful city.

Some cities have obtained good results with circular letters signed by some public official. These are usually sent to the various organizations, ministers and physicians, ask-

ing them to urge the cooperation of their members, congregations or the households they visit.

A few cities have adopted the plan of sending letters to all advertisers and every concern known to manufacture, advertise or sell any kind of an article used for cleaning purposes, requesting them to increase the amount of local publicity.

New York City in one campaign used four million circulars printed in five languages. One circular reads as follows:

"To every owner, occupant, representative of any building, apartment, room, yard or vacant lot: You are hereby notified to prepare and place within the stoop line for removal all rubbish and waste material, from lots, lofts, fire escapes, cellars, yards, alleys, air shafts, rooms and apartments. Old bedding, rugs, paper, furniture, broken-up boxes, and barrels; glassware should be placed in barrels, boxes and bundles. It is against the law to throw materials in the streets. Neglect to comply with this notice will result in prosecution. The wagons will call at 8 A. M. Wednesday, May 20."

Placards bearing the silhouette figure of William Penn majestically swinging a broom over the city from his dizzy perch on top of the City Hall appeared in every one of the 3200 trolley cars during a Philadelphia campaign. These were placed in the front and rear entrances in such a way that only the figure was visible from the outside. The appearance of the black and white sketch minus title or descriptive matter of any kind was perplexing to the passengers on entering the car, and they immediately looked at the reverse side for an explanation. They got it in the form of an announcement for the annual Clean-up Week, with just enough information and advice to be profitable, and most effective. This same figure was also distributed among the schools, libraries, railroad stations and other prominent places.

In various cities buttons are distributed bearing such inscriptions as "Clean Up and Paint Up. I Will, Will You?" and "Scoot Home and Scrub." Slogans are usually selected after competition for a prize by the school children.

Among the most effective posters used are window signs to call rubbish carts, and cards to be placed in the windows of homes. One house poster announced "We are Assisting in the Clean-Up and Paint-Up Campaign. Are You?" Posters have also been used in street cars, and on wagons and motor trucks. Fire warning cards have been sent by some cities to cigar stores, fire-proof material manufacturers, and gas companies.

Rochester, New York, was one of the first cities to have fire warnings printed on caps for milk bottles. Others have used the backs of transfer tickets issued by street railway companies. One of the most effective fire warnings read: "See that your good cigar or cigarette does not cause a bad fire." Philadelphia distributed blotters among the school children. In Toledo the school children, dressed as little White Wings, carried banners bearing the inscription "B-R-I-G-H-T-E-N U-P." The bill posting companies, in some instances, donate space for the use of large posters. Street cars and station platforms are also utilized in an effort to attract the attention of citizens to do their duty cleaning their premises. The delivery forces of department stores and milk companies are pressed into service, each wagon being supplied with pamphlets and cards to be left with each package or bottle of milk.

Motion pictures and lantern slides showing the ravages of the fly, and actual conditions existing from dirt are an important factor in bringing the necessity for cleanliness before citizens and school children. By way of stimulating effort in the school children of Kewanee, Illinois, motion pictures were shown depicting the success of children in beautifying their school grounds and gardens in other cities. The members of the New York Street Cleaning Department

gave illustrated lectures during the Clean-Up Campaigns. On the screens of 205 motion picture theaters in Philadelphia were shown nightly for four weeks attractively arranged slides telling the audience what to do and how to do it. The "Before" and "After" clean-up pictures proved very popular and instructive. Because of the great popularity of motion pictures this form of advertising is especially effective. The general secretary of the campaign in Cincinnati had prepared a set of lantern slides from photographs one year and these were used to illustrate addresses given the next year.

In all large cities there is much private advertising during these campaigns. In some, the regular advertising pages of the newspapers for weeks have individual advertisements of department stores, calling attention to the reduced prices of articles used for cleaning purposes. The more enterprising managers try to outrival each other in the amount of space covered.

Rochester, New York, one of the pioneer cities in the organization of the clean-up movement, arranged its publicity for one of its recent campaigns thus:

The cooperation of the daily press.

The exhibition of slides in motion picture theaters.

Sending letters to all lodges and orders asking for cooperation.

Asking the light companies to print fire warnings on the backs of their bills, and the railway companies to do the same on their transfers. The light companies also displayed similar information on their electric signs.

Use of the Boy Scouts to distribute dodgers to householders.

The cooperation of the clergy in preaching proper sermon.

Cooperation of the real estate exchange in cleaning up and keeping clean all buildings, of which the exchange has charge.

Inducing manufacturers to print suitable copy on pay envelopes.

Sending fire warnings in printed form to cigar stores.

Arrange that all caps for milk bottles during clean-up week be printed with a fire warning.

Secure the cooperation of all concerns selling fireproof materials such as cement, asbestos, fireproof paint and roofing, by asking them to advertise heavily during the week.

The Commissioner of Public Works consented to allow posters to be placed on the back of rubbish wagons, and the Commissioner of Public Safety offered the use of the big fire engines for the same purpose.

The Cooperating Forces

The greater the number of cooperating forces and agencies the more successful will be the campaign. All contribute to make the city more livable.

The greatest factor in the clean-up movement is the children. Nothing that is done can be accomplished without their help. Of the hundreds of cities interested in clean-up campaigns very few can be found where the school children have not been actively identified with the work. No stone has been left unturned to encourage the teachers to give the children the clean-up spirit. One of the best means of reaching adults is through their children, and the education of the children themselves along these lines will contribute materially to their sense of proper community conditions when they become men and women. It is acknowledged that what is most needed in a boy nowadays is the right spirit, to insure him a clean life in talk, habits and associates; keeping the city's streets clean is a certain responsibility that makes him more careful in his own habits.

Children are pressed into service in many ways,—through clubs composed of boys and girls, Boy Scouts, Camp Fire Girls, City Clubs, Junior League Clubs and Junior

Civic Clubs. Cleveland, Chicago, New York, Spokane, Paterson, N. J.; Salt Lake City, Dallas, Texas; Toledo, Ohio; Denver, Colo.; Cincinnati, Pensacola, Fla.; Bay City, Oregon; Antlers, Okla.; Denison, Texas, are only a few of the cities where children have been active.

There are various ways of rewarding the children for their work. Some cities believe that money prizes appeal to children more than medals, badges, etc., and so have created special funds for that purpose, usually collected by some civic organization. Other cities give medals, buttons, puzzles, school equipment—stereopticon with lantern slides, maps, pictures, plans;—sporting equipment—baseball and football masks, balls and bats, cameras, free tickets to moving picture theaters.

In some instances the school children have become enthusiastic to the point of organizing magazines in the schools, devoted entirely to the Clean-Up Campaign. The children of the Clifton School in Cincinnati issued a magazine called *The School Circle.*

In some cities packets of flower and garden seeds are distributed among the children, and all vacant lots, back yards and stretches of ground not utilized are cleared of rubbish and dug up and seeded.

Under the direction of a Captain, school boys of Spokane, Washington, were organized into corps which cleaned up the residence section, then hauled the refuse away to the public dumps in wheelbarrows and express wagons.

Another method used to good advantage by Salt Lake City was to get the boys of each district bordering on dirty vacant lots to clean them up and prepare them for baseball grounds. After this had been done the Inspector of Public Health gave the boys baseball bats, balls and equipment.

At the suggestion of Mayor Cochran of Antlers, Oklahoma, the Progressive Club and the Ladies' Civic Club combined in a program that was very successful. The boys of the city gathered up all the rubbish and placed it on the

curbs, and the city wagons removed it. A committee appointed by the club solicited funds to reward the boys.

As a preliminary to the general clean-up movement in Bay City, Oregon, the Commercial Clubs, in conjunction with the Ladies' Civic League, offered three prizes to the boys collecting the greatest number of sacks of rubbish by April 5.

One city in Ohio gave each child collecting one hundred tin cans a free ticket to a motion picture theater.

Judge Albert Besson of Chelsea, Mass., found a novel use for six boys, averaging fifteen years old, brought before him for sentence for entering freight cars and stealing candy. He sentenced them to keep a certain city street clear of waste for six months. The street in question is a long one, and friends of the boys living on it made things interesting for the culprits keeping the cigarette stubs, tin cans, papers and milk bottles picked up. The boys were supervised by two policemen.

The children of the sixth and seventh grades in one school in Inchester, Pa., started a tin can crusade, which aroused every citizen in the city. With two days of the contest still to run, the children had gathered 37,000 tin cans.

In accordance with the proclamation of the Governor, the Mayor of Montpelier, Vermont, observed April 25 as Arbor Day and Clean-Up Day. Outdoor exercises were held, including an address by the Mayor. The children were not required to attend school in the afternoon provided they spent two hours cleaning up the streets and grounds about their homes.

Toledo school children were divided into squads and to each was given a section of a ward. Each day a ward was cleaned and the results were printed in the next day's papers, thus creating rivalry among the children.

Everywhere the Boy Scout has found his level in the Clean-Up Campaign. It is a Scout law that he must be clean. Almost every troop of Scouts has done its full quota

in civic, local or county clean-ups. In patrol or by troop they care for school grounds, public grounds, make systematic campaigns against flies and mosquitoes, destroy their breeding places; plant trees, bushes and shrubs; in general, keep the streets free of litter and waste of all kinds. Divided into squads, they do much for city betterment. Vacant lots, waste property, fields and streets are rid of tin cans, milk bottles, scrap iron, weeds, and in their places flowers, vegetables and shrubbery planted; unsightly billboards removed. Sometimes they are paid for their work by the Civic Leagues, as in the case of Cornwall, N. Y., and St. Paul, Minnesota.

In many cities the Scouts have done splendid work in inspection duty, reporting all unsanitary conditions. In patrols, troops or companies they are assigned to investigate and report to the superintendent of streets or the organization having charge of the clean-up. The inspection is done day by day as the clean-up progresses, and any oversight or unsanitary condition reported at once.

Another method of interesting children is the organization of boys and girls into what is known as City Clubs, whose duty it is to keep the streets clean. The clubs are limited to 25 members each. The members wear buttons and each one is provided with blanks on which to report. In some instances these clubs work throughout the year but usually their work is confined to the spring clean-up, in which event they attend to the general clearing up of vacant lots, back yards, school property, and cart it to the curbs for the city dump wagons to haul away.

In Boston, under the auspices of the Women's Municipal League, the Junior Municipal League, loaded with posters reading "Do you have pride in your city? Then Clean It Up," and armed with brooms, shovels and rakes, proceeded to clean up. "Little Italy" was no small job. How the children first became interested in cleaning up this district is told about a little Italian girl who persuaded her merchant

father to put covers on his barrels because the papers blew about and littered the back yard. This so improved the appearance that the child decided to sweep the back porch every morning before going to school. One morning a policeman saw her doing this and remarked on the improvement and gave her a button; immediately all the children in the neighborhood became industrious.

Gratifying results were obtained in Kewanee, Illinois, through the cooperation of the Superintendent of Schools and the Junior Civic Club, consisting of 650 members from the seven schools of the city. To each pupil desiring to become a member was presented a button in the school colors, bearing the words "I Will Help Kewanee." A photograph was taken of the child's home, showing as clearly as possible what he desired to improve. A letter was sent to the parents of the members of the Club, stating that the Kewanee Civic Club offered prizes to children who would make the most progress in cleaning up yards at home, plant flowers, make gardens, and do any other work. For the best showing in each school district $5 in gold was first prize, and $2.50 in gold second prize. To all the children who made an honest effort to clean up and beautify their yards were given diplomas of award signed by the Superintendent of Schools and the Committee. The taking of the pictures was a most expensive plan, but the expenses were materially reduced because the Camera Club of the High School contributed largely of their time. A contest in growing vegetables and making gardens was begun in the summer, and in the fall prizes were offered for the best showing. In order to stimulate interest in that direction, motion pictures showing what children had done in other cities were used.

A school in one city presented a one-act play typifying the following characters: Fly, waste, paper, fire, soot, dirt, microbe, sickness, death, sorrow, poverty, cleanliness, swatter, refuse pail, fire prevention, paint, scrub brush, soap, water and flowers. Lines were fitted to each character, and

in the end cleanliness and happiness overcame sickness and dirt.

Although not always taking an active part in the cleaning up, women's clubs have been a great factor for good in instigating general clean-up. There is scarcely a city in the country where the women in one way or another have not done much propaganda work, and in many instances offered active service and financial support.

Cincinnati is unanimous in its opinion that it owes its successful campaigns to the Cincinnati Woman's Club, which organization was responsible for the first effort toward a general clean-up years ago.

The prominent women residents of Cornwall, N. Y., members of the Improvement Society, having failed to get the Moodine Creek and adjacent property cleaned up by the Board of Health, after an appeal, formed what they called the Tin Can Committee, and started a campaign of housecleaning on their own account. Flanked by a squad of Boy Scouts, they marched to the Moodine with rakes and hoes and began to clean up the thickets of the creek on both sides.

Special Activities

Besides the general cleaning work for the removal of rubbish and waste many cities add special activities to their programs. These are found to be helpful in improving both sanitary and esthetic conditions. In a few cities drastic measures are resorted to in special cases. In Philadelphia, for example, the names of 600 owners of unimproved property which required cleaning were obtained and to each was sent a written request to improve conditions. The results were gratifying. In other places photographs of unsanitary conditions have been taken and the pictures either published or sent to the owners or occupants of the premises.

In Chicago an agitation was started to clean the roofs in the downtown district, as it was claimed that most of the

dirt filling the air and streets was blown from the roofs, which had not been cleaned since they were built.

School gardens and tree planting are popular in many cities and are made a part of the Clean-Up Campaign program.

Through tireless energy the Director of Social Centers of the public schools in Cincinnati succeeded in having hundreds of school gardens planted. Many of these were planted in vacant lots which had formerly been the abiding place of heaps of rubbish. One was upon what had been for years an objectionable public dump adjacent to a school. Several loads of dirt were applied in the fall and the cost defrayed from the campaign fund. In September an exhibit of school garden products was held and prizes offered.

Intensive vacant lot and back yard gardening campaigns were conducted in most American cities during the spring and summer of 1917. Although these campaigns resulted from the need to increase production, they assisted materially in eliminating many unsanitary spots in every city.

A Cincinnati firm in former years distributed trees in great numbers among the school children of the city and adjacent communities. Upon the suggestion of the Clean-Up Committee it decided again to make such distribution as a part of the Clean-Up Campaign, this time peach trees. Cards were given to all the school children who would agree to plant and care for the trees. Eighty-four thousand of these trees were distributed. The trees planted will bear fruit worth many thousands of dollars. The distribution of them formed a distinctive and unique feature of the Cincinnati campaign.

Fire Prevention and Inspection

The fact that in Philadelphia in one year the loss by fire from combustible materials alone was $300,000 shows how important is fire prevention in the clean-up work. Realizing the conditions and the effective means which clean-up

INSPECTOR'S REPORT (1915).
"CLEAN-UP AND PAINT-UP" CAMPAIGN.
Under Auspices of Cincinnati Chamber of Commerce.

Ward INSPECTOR'S REPORT *Precinct*
Location ..... Date ..... 191....
Occupation .....
Owner or Agt .....
Address .....

Instructions—Inspect Entire Premises.
Note Defects by Opposite Key Nos.

	1st Insp.	2nd Insp.
Cellar		
Hallways		
1st Story		
2nd Story		
3rd Story		
4th Story		
5th Story		
6th Story		
Attic		
Yard		
Alley		
Vacant Lot		
Stable		
Store		

1. Rubbish (including rags and waste paper).
2. Garbage in other than covered metal cans.
3. Ashes in other than covered metal cans or pails.
4. Old lumber or furniture.
5. General Unclean Condition.
6. Fire Escapes Obstructed.
7. Hallways or Stairways Obstructed with goods.
8. Unsanitary Toilet.
9. Privy Vault.
10. Open manure pile.
11. Frame Fire Risks to be Torn Down.

Other Defects .....

Do Not Fill Out
Referred to Date
State F. M .....
Police Dept .....
Fire Dept .....
Health Dept .....
Bldg. Com .....

Department ..... (Signed) ....., Inspector.
Fire Map ..... Vol. ..... Page ..... Block .....

No. and Street .....

Items for Clean-Up Attention

Front Yard	Ashes	Paper
Side Yard	Ashes	Paper
Back Yard	Ashes	Paper
Sawdust	Wood	Rubbish

Old Barrels, Boxes, etc .....
Vacant lot to be rid of .....
Other Conditions .....

Items for Public Health Attention

Garbage .....
Outside Vaults .....
Stable Nuisances .....
Drainage .....
Other Conditions .....

campaigns offer to improve them, many cities have laid special emphasis upon safety as well as sightliness and cleanliness. The effort of Cincinnati illustrates the results that have been achieved in many other communities.

"The success attained in the Cincinnati campaign in 1914 so impressed the State Fire Marshal that he assigned one of his assistants to spend his entire time in the 1915 season going about the State organizing in the different cities clean-up campaigns based upon the Cincinnati plan, and in which inspections by the State Fire Marshal's department played an important part. Since it is estimated that 80 per cent. to